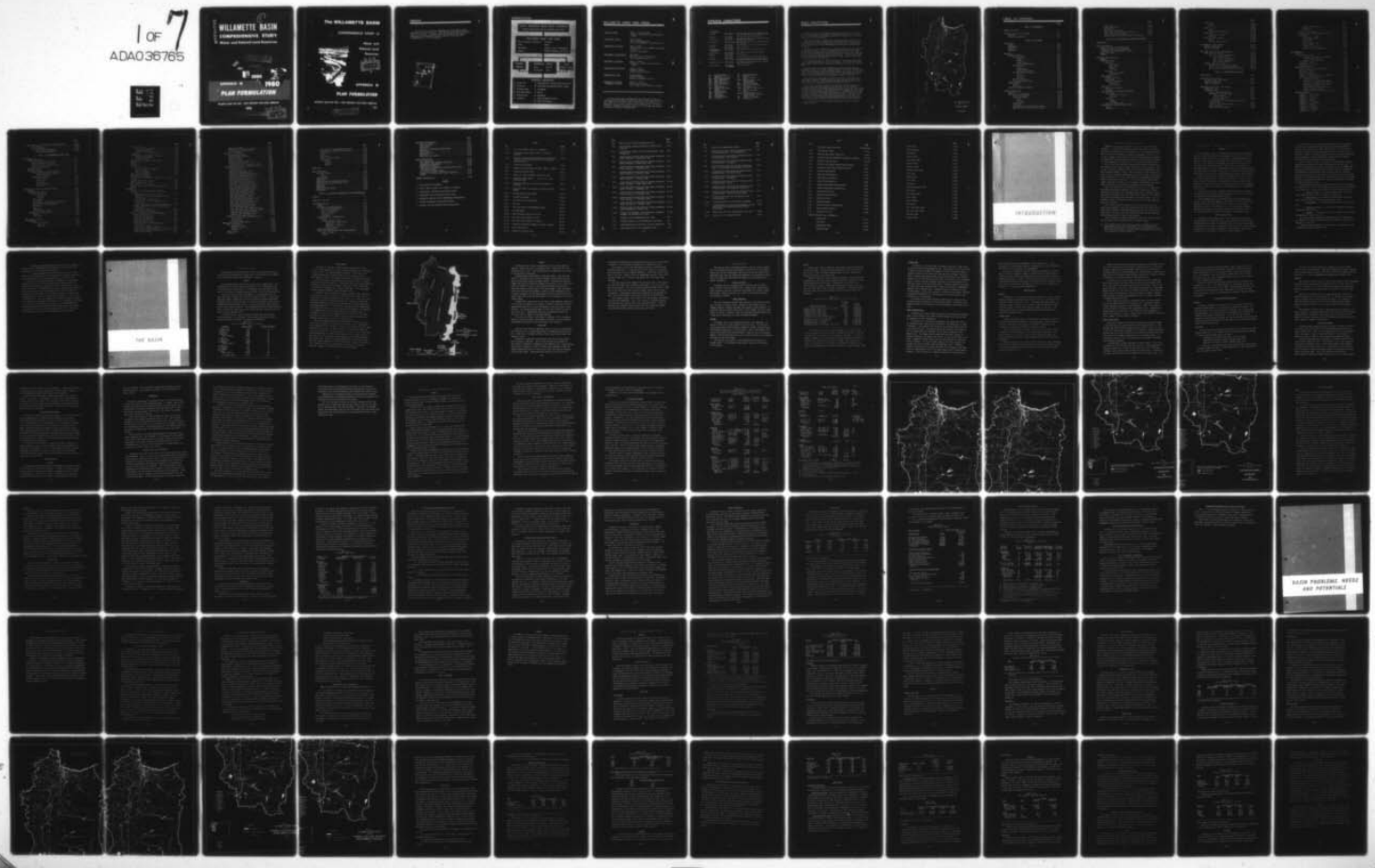
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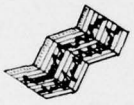
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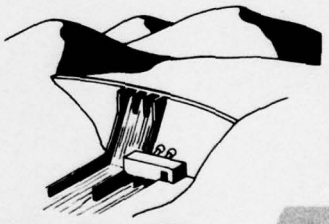
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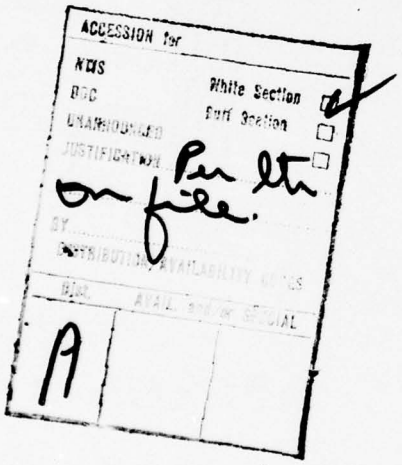
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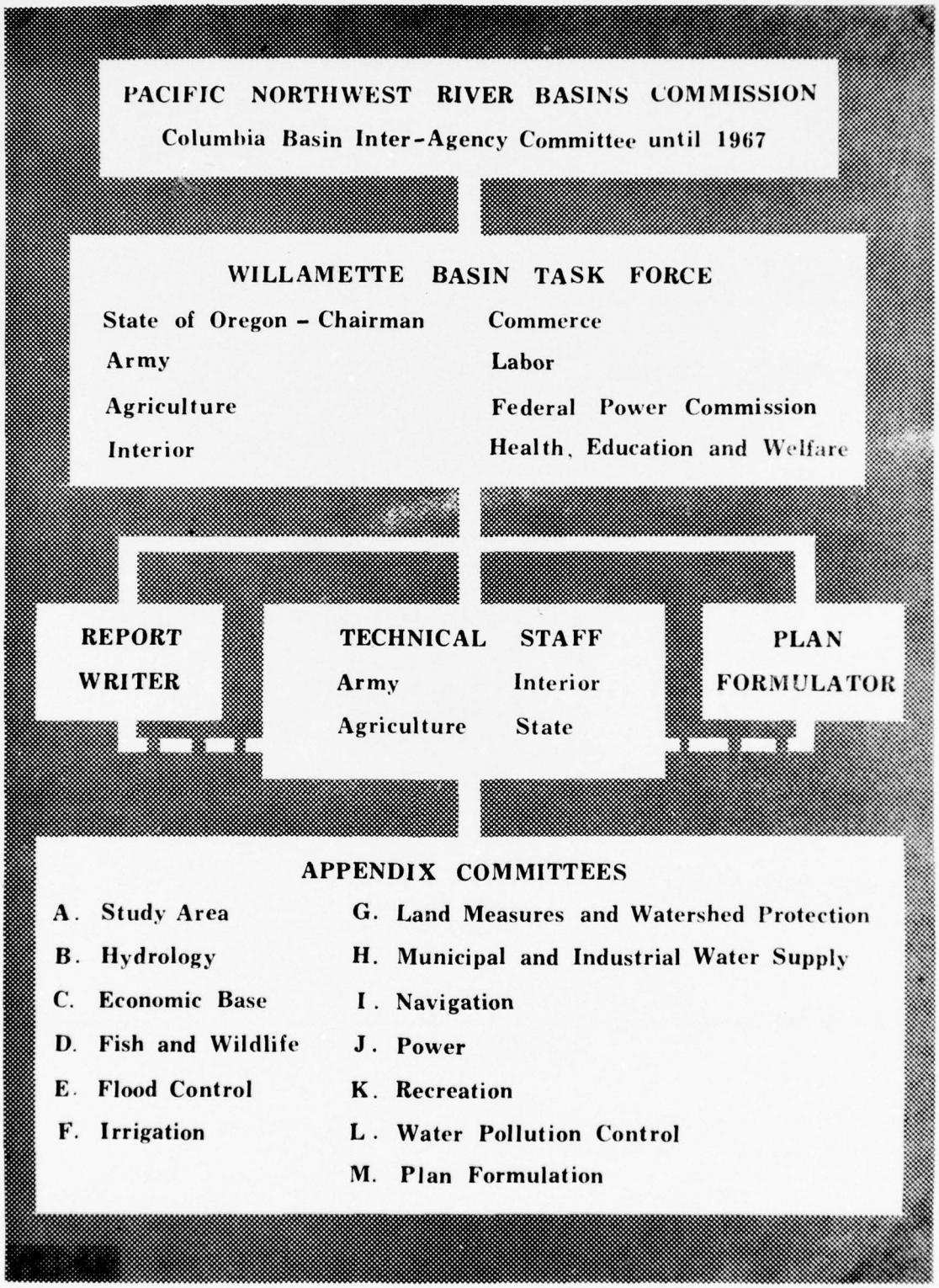
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CREDITS

This is one of a series of appendices to the Willamette Basin Comprehensive Study main report. Each appendix deals with a particular aspect of the study. The main report is a summary of information contained in the appendices plus the findings, conclusion, and recommendations of the investigation.



ORGANIZATION



WILLAMETTE BASIN TASK FORCE

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Department of Army	Henry Stewart Chief, Planning Branch U. S. Army Engineers, Portland District
Department of Interior	John F. Mangan Area Engineer, Lower Columbia Development Office Bureau of Reclamation
Department of Agriculture	Oke Eckholm Assistant State Conservationist Soil Conservation Service
Department of Commerce	David J. Bauman Hydrologist, Weather Bureau Forecast Center
Federal Power Commission	Gordon N. Boyer Hydraulic Engineer Federal Power Commission
Department of Labor	Horace Harding Regional Economist Bureau of Employment Security
Department of Health, Education & Welfare	Francis L. Nelson Public Health Service Water Supply and Sea Resources Program

The Willamette Basin Comprehensive Study has been directed and coordinated by the Willamette Basin Task Force, whose membership as of April 1969 is listed above. The Task Force has been assisted by a technical staff, a plan formulator, and a report writer - Executive Secretary. Appendix committees listed on the following page carried out specific technical investigations.

APPENDIX COMMITTEES

Appendix-Subject		
A - Study Area	OSWRB - Chairman:	FWPCA, USBPA, USBLM, USBM, USBOR, USBR, USBSF&WL, USCE, USERS, USFS, USGS, USNPS, USSCS, OSDC, OSDF, OSDG&MI, OSS&WCC, OSU
B - Hydrology	USGS - Chairman:	FWPCA, USBPA, USBR, USCE, USSCS, USWB, OSE, OSWRB
C - Economic Base	USCE - Chairman:	FWPCA, USBPA, USBCF, USBM, USBOR, USBR, USBSF&WL, USDL, USERS, USFS, OSDC, OSU, UO, PSC-PR&C
D - Fish & Wildlife	USBSF&WL - Chairman:	FWPCA, USBCF, USBLM, USBOR, USCE, USDA, USFS, USGS, USSCS, OSFC, OSGC, OSWRB, USHEW
E - Flood Control	USCE - Chairman:	FWPCA, USBR, USDA, USGS, USSCS, USWB, OSDC, OSE, OSWRB, UO
F - Irrigation	USBR - Chairman:	USSCS, OSDC, OSWRB, OSU
G - Land Measures and Watershed Protection	USSCS - Chairman:	FWPCA, USBCF, USBLM, USBOR, USBR, USBSF&WL, USFS, OSU
H - M&I Water Supply	FWPCA - Chairman:	USBR, USBSF&WL, USGS, USSCS, OSBH, OSDC, OSWRB, USHEW
I - Navigation	USCE - Chairman:	OSDC, OSMB, POP, OSU
J - Power	USBPA - Chairman:	FPC, FWPCA, USBCF, USBR, USCE, USFS, USGS, OSE, OSWRB
K - Recreation	USBOR - Chairman:	FPC, FWPCA, USBLM, USBSF&WL, USCE, USFS, USNPS, USSCS, OSBH, OSDC, OSFC, OSGC, OSHD-PD, OSMB, OSWRB, LCPD, OCPA, USHEW
L - Water Pollution Control	FWPCA - Chairman:	USBCF, USBLM, USBOR, USBR, USBSF&WL, USGS, USSCS, OSBH, OSE, OSFC, OSGC, OSWRB, OSU, USHEW
M - Plan Formulation	Plan Formulator - Chairman:	USCE, USDA, USDI, OSWRB

FPC - Federal Power Commission
FWPCA - Federal Water Pollution Control Administration
USBPA - Bonneville Power Administration
USBCF - Bureau of Commercial Fisheries
USBLM - Bureau of Land Management
USBM - Bureau of Mines
USBOR - Bureau of Outdoor Recreation
USBR - Bureau of Reclamation
USBSF&WL - Bureau of Sport Fisheries and Wildlife
USCE - Corps of Engineers
USDA - Department of Agriculture
USHEW - Department of Health, Education and Welfare
USDI - Department of Interior
USDL - Department of Labor
USERS - Economic Research Service
USFS - Forest Service
USGS - Geological Survey
USNPS - National Park Service
USSCS - Soil Conservation Service
USWB - Weather Bureau

OSBH - Oregon State Board of Health
OSDC - Oregon State Department of Commerce
OSDF - Oregon State Department of Forestry
OSDG&MI - Oregon State Department of Geology and Mineral Industries
OSE - Oregon State Engineer
OSFC - Fish Commission of Oregon
OSGC - Oregon State Game Commission
OSHD-PD - Oregon State Highway Department - Parks Division
OSMB - Oregon State Marine Board
OSS&WCC - Oregon State Soil and Water Conservation Committee
OSWRB - Oregon State Water Resources Board
OSU - Oregon State University
PSC-PR&C - Portland State College - Center for Population Research and Census Service
UO - University of Oregon
LCPD - Lane County Parks Department
OCPA - Oregon County Parks Association
POP - Port of Portland

BASIN DESCRIPTION

Between the crests of the Cascade and Coast Ranges in northwestern Oregon lies an area of 12,045 square miles drained by Willamette and Sandy Rivers--the Willamette Basin. Both Willamette and Sandy Rivers are part of the Columbia River system, each lying south of lower Columbia River.

With a 1965 population of 1.34 million, the basin accounted for 68 percent of the population of the State of Oregon. The State's largest cities, Portland, Salem, and Eugene, are within the basin boundaries. Forty-one percent of Oregon's population is concentrated in the lower basin subarea, which includes the Portland metropolitan area.

The basin is roughly rectangular, with a north-south dimension of about 150 miles and an average width of 75 miles. It is bounded on the east by the Cascade Range, on the south by the Calapooya Mountains, and on the west by the Coast Range. Columbia River, from Bonneville Dam to St. Helens, forms a northern boundary. Elevations range from less than 10 feet (mean sea level) along the Columbia, to 450 feet on the valley floor at Eugene, and over 10,000 feet in the Cascade Range. The Coast Range attains elevations of slightly over 4,000 feet.

The Willamette Valley floor, about 30 miles wide, is approximately 3,500 square miles in extent and lies below an elevation of 500 feet. It is nearly level in many places, gently rolling in others, and broken by several groups of hills and scattered buttes.

Willamette River forms at the confluence of its Coast and Middle Forks near Springfield. It has a total length of approximately 187 miles, and in its upper 133 miles flows northward in a braided, meandering channel. Through most of the remaining 54 miles, it flows between higher and more well defined banks unhindered by falls or rapids, except for Willamette Falls at Oregon City. The stretch below the falls is subject to ocean tidal effects which are transmitted through Columbia River.

Most of the major tributaries of Willamette River rise in the Cascade Range at elevations of 6,000 feet or higher and enter the main stream from the east. Coast Fork Willamette River rises in the Calapooya Mountains, and numerous smaller tributaries rising in the Coast Range enter the main stream from the west.

In this study, the basin is divided into three major sections, referred to as the Upper, Middle, and Lower Subareas (see map opposite). The Upper Subarea is bounded on the south by the Calapooya Mountains and on the north by the divide between the McKenzie River drainage and the Calapooia and Santiam drainages east of the valley floor and by the Long Tom-Marys River divide west of it. The Middle Subarea includes all lands which drain into Willamette River between the mouth of Long Tom River and Fish Eddy, a point three miles below the mouth of Molalla River. The Lower Subarea includes all lands which drain either into Willamette River from Fish Eddy to its mouth or directly into Columbia River between Bonneville and St. Helens; Sandy River is the only major basin stream which does not drain directly into the Willamette.

For detailed study, the three subareas are further divided into 11 subbasins as shown on the map.

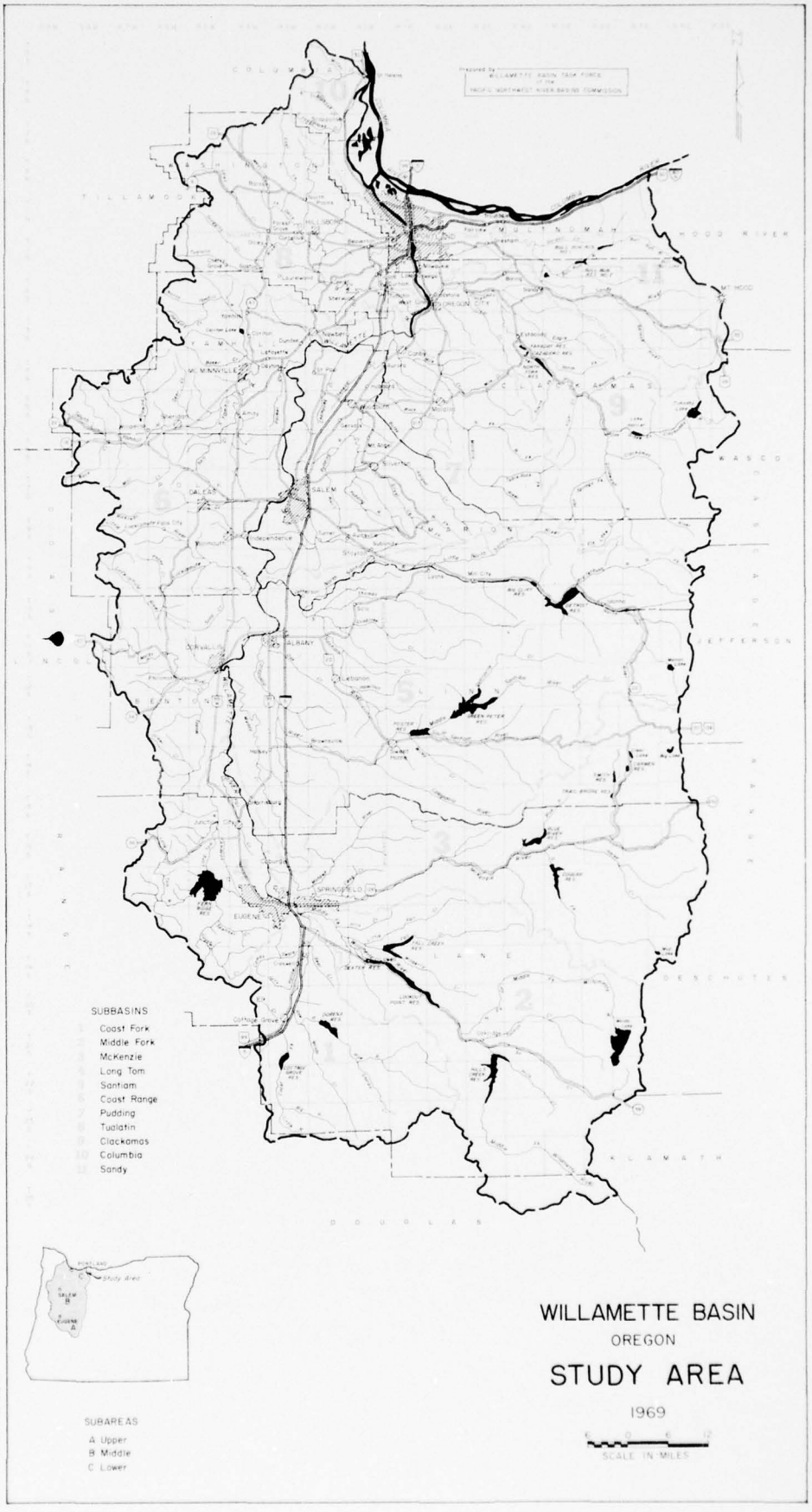

SUBBASINS
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Middle Fork
McKenzie
Long Tom
Santiam
Coast Range
Pudding
Tualatin
Clackamas
Columbia
Sandy
SUBAREAS
A Upper
B Middle
C Lower
WILLAMETTE BASIN
OREGON
STUDY AREA
1969
SCALE IN MILES

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B - LIST OF PUBLIC HEARINGS AND SUMMARY OF TESTIMONY

C - INVESTIGATION PROCEDURES AND PROJECT STUDIES

D - PRELIMINARY PLAN HANDOUT DATED AUGUST 1968

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INTRODUCTION

PURPOSE AND SCOPE

Appendix M is prepared primarily for the use of the technical reviewer. It summarizes the basis for plan formulation, and presents the details and results as the culmination of a coordinated multiagency study of water and related land resource development. Because it is in part a summary, please refer to basic data and functional appendixes for background data and details of materials briefed herein. Reference to those appendixes, as appropriate, is included in subsequent text.

Part I sets forth the basic concept which guided plan formulation, and discusses goals and objectives consistent with that concept. Parts II and III provide a summary picture of the overall background or setting in which planning is done. Part II tells the reader, briefly and with a view to a general understanding of problems, needs, and potentials, what the basin is. Part III covers present and projected problems and needs and available potentials. All of the potential project functional fields now recognized by the Congress, environmental and social needs, and legal and institutional considerations are included.

Part IV is devoted to the formulation of a plan. It covers plan formulation procedures in general, the overall sequence of actions developed to make best use of available data, and the specific formulation data and rationale used. It outlines the rationale for selection of projects and programs for inclusion in the overall plan. Also, it provides a basis for selection of the early-action and long-range elements of that plan.

Part V sets forth the elements of the overall plan; lists the early-action elements of the plan; describes effects and impacts of the early-action elements; summarizes unmet needs, after the early-action stage and for the total plan; and outlines alternatives and opportunities available beyond the plan as now defined.

Part VI contains a summary discussion of the study, and the resulting conclusions and recommendations of the Task Force. 1/

1/ *The Willamette Basin Task Force was formed by CBIAC, but operated under auspices of the Pacific Northwest River Basins Commission during much of the study, to coordinate the study activities of the State and Federal agencies involved. Part IV contains additional data on organization for plan formulation.*

CONCEPTS, GOALS, AND OBJECTIVES

CONCEPTS

The multiagency study of Willamette River Basin, and specifically this Plan Formulation Appendix, was prepared in the light of one basic concept, shared generally by all concerned: Willamette Basin now is and must remain a generally desirable place for people to live, work, and play. Its resources, environment, and culture run the gamut from the primitive to the sophisticated. This permits the exercise of a reasonable degree of choice in substantially all phases of human activity, and particularly in leisure time activity. It also provides the resource base needed to plan for action consistent with the basic study concept.

Inherent in that basic concept is recognition that water and related land resource problems and unsatisfied needs now exist. Population, and use of resources, is predicted to increase rapidly in the future, and barring unforeseen circumstances will do so. Thus, present problems will tend to be aggravated, and present needs to be magnified, in the future.

Under those conditions, the general desirability and livability of the basin will deteriorate if proper planning is not done and if plans so developed are not implemented as needed.

The multiagency study was initiated with the understanding that Federal, State, and local agencies; individuals; and groups would work together to plan for the future. That concept has been retained throughout the study. Corollary to it is the concept that, between and among the Federal, State, and private entities involved there is or can be developed the ability to implement a comprehensive plan.

GOALS AND OBJECTIVES

Consistent with National policy, the aforestated basic concept, and the authorities under which this study was made, the goal of plan formulation was to provide for the best uses of resources to meet needs. In striving for that goal, consideration was given to the primary National objectives of development, preservation of environment, and the well-being of all of the people, as shown in Senate Document 97.

Interrelated to that goal and those objectives, and mentioned subsequently in Water Resources Council and other planning guidelines, are many other expressions of goals and objectives. Those other expressions of goals and objectives, some published after this study was initiated, include: National economic efficiency; regional (Appalachia-type) development; income redistribution; population and industry dispersal; political equity; and local acceptance.

Only the Senate Document 97 statement of three primary National objectives was available when the Willamette study was initiated. The Task Force recognized that complete attainment of the development and preservation objectives probably would not be possible. Development and preservation considerations often present a need for reasoned choice; the well-being of people may be a deciding factor in such cases. However, it was recognized that other considerations might be pertinent, and that more detailed expressions of goals and objectives were needed to guide the planning effort.

To provide that guidance and facilitate the best use of resources for the well-being of all of the people, the Task Force early established five broad goals. Listed without order of priority, those goals are:

a. Economic Growth. - To insure economic growth and production consistent with efficient allocation of resources.

b. Conservation. - To conserve land and natural resources, and to preserve and/or enhance their potential for use.

c. Environment. - To maintain a pleasant place for people to live.

d. Health and Safety. - To provide for the health and safety of human and animal life.

e. Leisure. - To increase the choice of leisure time activity consistent with people's desires.

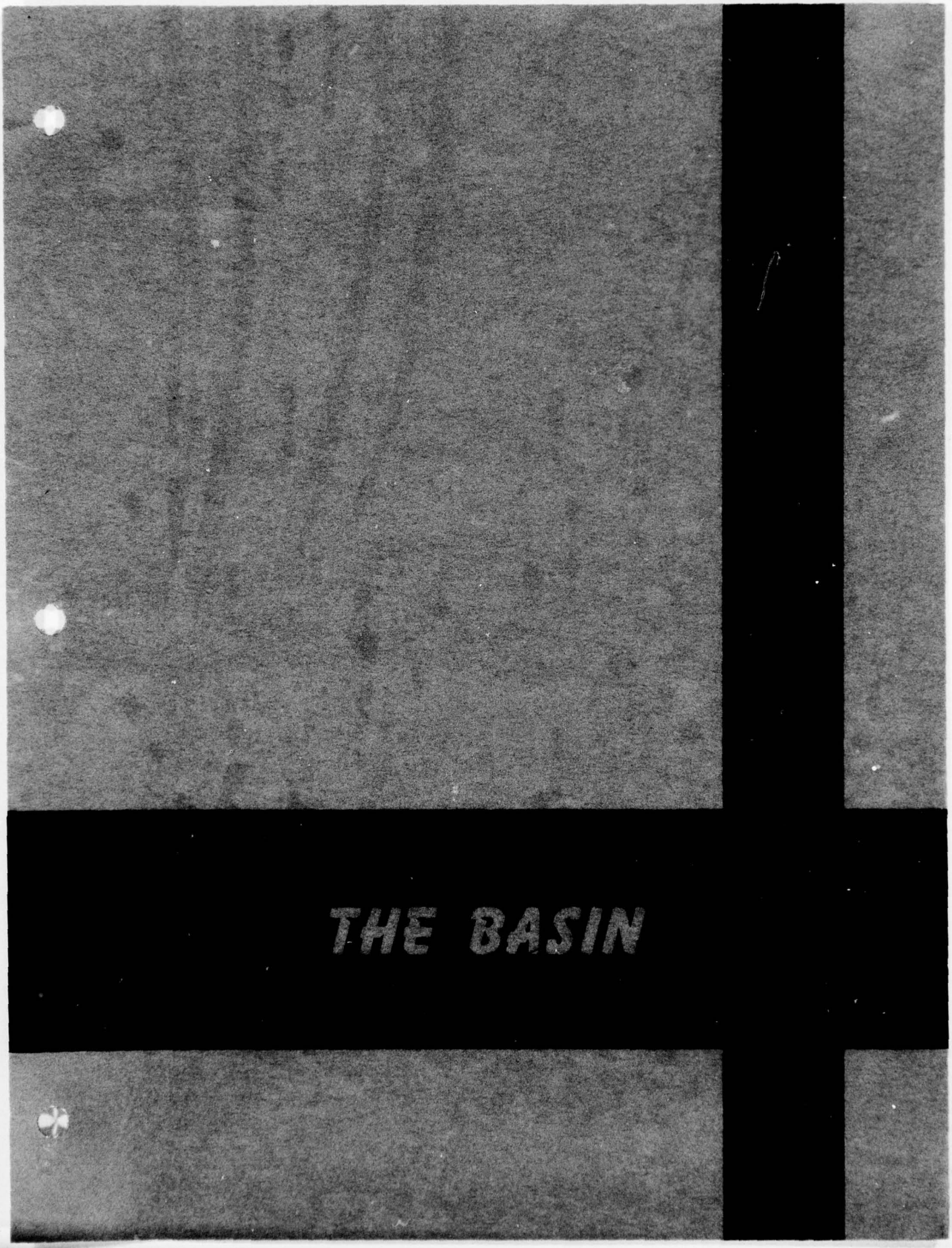
The relationships between those broad goals and the functions to be considered in plan formulation are shown on pages IV-4 and IV-5 of Appendix A, Study Area.

Additional goals adopted by the Task Force in accordance with the principles of Senate Document 97 are:

a. National economic efficiency, which requires a showing of economic returns commensurate with project cost and of the level of development which would maximize net benefits.

b. Local acceptance, as a guide to planning and as a prerequisite to implementation of plan elements which involve functions for which reimbursement, or local participation, is required by law.

Other goals and objectives, either not adopted or recognized as applicable only in part, include population and industry dispersal, regional (Appalachia-type) development, income redistribution, and political equity. The population and industry dispersal goal was recognized as applicable only to the extent that it would be related to nonstructural alternatives for flood damage reduction. Regional development was not a specific goal because the basin as a whole is not a depressed area. Also, as pointed out in Appendix A, basin residents are a segment of the Nation's population and the well-being of the basin is a factor in the well-being of the Nation. Any consideration of income redistribution involving Willamette Basin versus other basins is a matter for action at levels beyond the Task Force. Similarly, political equity is a matter for consideration at other levels.


THE BASIN

DESCRIPTION

The summary description herein is based on more detailed coverage in the basic data Appendixes A, Study Area; B, Hydrology; and C, Economic Base, and the nine functional appendixes, D through L.

GENERAL

The Willamette Basin study area is shown on the frontispiece. Its 12,045-square-mile area consists principally of the 11,200-square-mile Willamette River drainage basin. It represents about one-eighth of the area of the State and contains about two-thirds of the State's population.

The study area is roughly rectangular. Its north-south axis is about 150 miles in length, and its width averages 75 miles. The Cascade and Coast Ranges, respectively, form its eastern and western boundaries. Willamette River, formed initially by tributaries heading in the Calapooya Mountains and Cascade Range, runs from south to north and joins Columbia River at the northern boundary. The 3,500-square-mile area along Willamette River, between the ranges and generally below 500 feet, mean sea level, is known as the Willamette Valley.

For study purposes, the total area is broken down to three subareas consisting of 11 subbasins. The following table shows a breakdown of the total study area, by subbasins and subareas:

Table II-1
Area of Willamette Basin, by subbasins

Subbasin	Square Miles	Percent of Basin
1 Coast Fork	665	6
2 Middle Fork	1,354	11
3 McKenzie	1,342	11
4 Long Tom	526	4
Upper Subarea	3,887	32
5 Santiam	2,440	20
6 Coast Range	1,794	15
7 Pudding	1,186	10
Middle Subarea	5,420	45
8 Tualatin	711	6
9 Clackamas	1,014	8
10 Columbia	431	4
11 Sandy	582	5
Lower Subarea	2,738	23
Willamette Basin	12,045	100

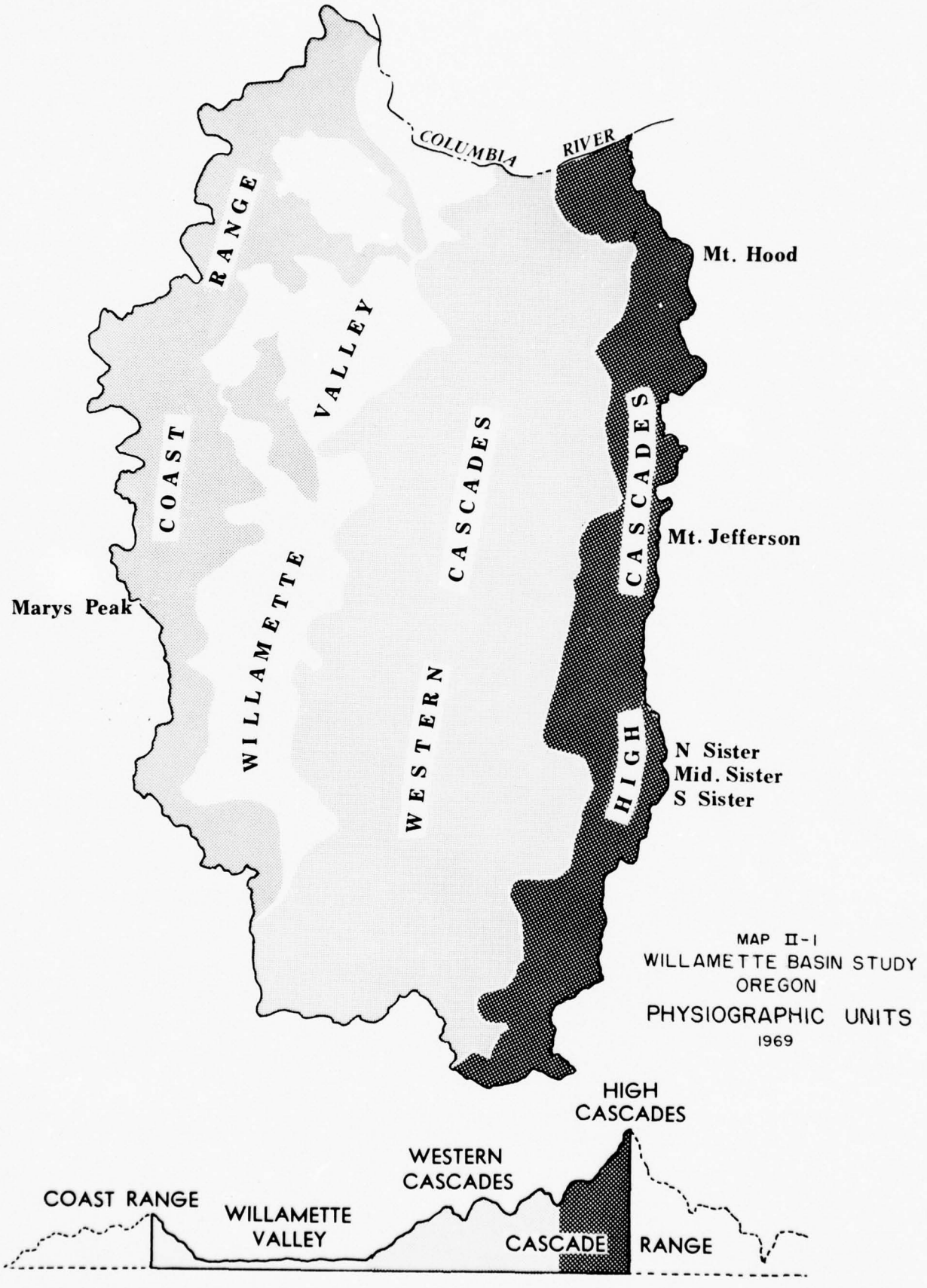
PHYSIOGRAPHY

The basin is composed of three distinct physiographic units: (1) the Coast Range, which forms the western boundary; (2) Willamette Valley; and (3) the Cascade Range to the east. Those units, all oriented north-south as shown on Map II-1, are integral parts of physiographic provinces extending far beyond the confines of the basin.

The Coast Range, paralleling the Pacific Ocean shore, is deeply dissected by water-cut canyons. Slopes are steep, even in the foothills. Elevations along the crest generally range from 2,000 to 3,000 feet. Marys Peak, the highest point, rises to 4,097 feet. The Coast Range occupies about one-eighth of the basin study area.

Willamette Valley, between the ranges, occupies almost one-third of the basin. Most of the valley is flat to gently rolling, but isolated hills and buttes protrude in many places. The valley floor is an alluvial terrace, only shallowly dissected by streams. In the upper and middle subareas, streams meander between low, unstable banks in a floodplain generally 2 to 3 miles wide. Toward the north (downstream) the floodplain narrows and streams are deeply entrenched. The gradient of Willamette River flattens progressively from south to north. It averages 6 feet per mile at Eugene, near the south end of the valley, but drops to almost 0 in the tidally affected reach downstream from Willamette Falls near the mouth of Willamette River.

The Cascade Range, separating western Oregon from the arid areas to the east, occupies more than half of the basin area. The general crest elevation is in the order of 5,000 feet but several volcanic cones rise above 10,000 feet. As shown on Map II-1, the Cascade Range consists of two subunits. The High Cascades, a platform 5 to 10 miles wide and with generally low relief, is the backbone of the range. Most of the range is in the Western Cascades subunit, at elevations generally below 4,000 feet. That area is deeply dissected by water-cut canyons, with side slopes ranging from 400 to 500 feet per mile in the foothills up to 3,000 feet per mile at the higher elevations. The principal tributary streams of the basin rise in the Cascade Range.


COLUMBIA RIVER
COAST RANGE
WILLAMETTE VALLEY
WESTERN CASCADES
HIGH CASCADES
Mt. Hood
Mt. Jefferson
Marys Peak
N Sister
Mid. Sister
S Sister
MAP II-1
WILLAMETTE BASIN STUDY
OREGON
PHYSIOGRAPHIC UNITS
1969
HIGH CASCADES
WESTERN CASCADES
COAST RANGE
WILLAMETTE VALLEY
CASCADE RANGE

CLIMATE

Willamette Basin climate is temperate, with a distinct seasonal regimen. Winters are wet, but generally mild. Summers are dry, and moderately warm to hot. Both precipitation and temperature are related to and affected by elevation.

Average annual precipitation is about 63 inches. More than two-thirds of the annual total falls from November through March and only about one-twentieth during the summer months. Precipitation intensity ranges from about two-thirds of average on the valley floor to more than twice the average on parts of the Cascade Range and more than three times the average on small parts of the Coast Range. Those differences result from the initial orographic lifting of moisture-bearing air as it passes basinward over the Coast Range, its flat trajectory over the valley floor, and the second and greater lift of less-moist air over the Cascade Range.

Average daily temperatures on the valley floor generally range from a low of about 38 degrees F. in January to about 67 degrees F. in July. Temperatures below zero or above 100 degrees F. are rare, and of short duration. The average growing season is more than 200 days on most of the valley floor. Temperatures drop with increasing elevation, and frost may occur in summer in the High Cascades.

All told, the climate of the basin is pleasant, with a reasonable degree of annual variation, and generally conducive to use of land and environmental resources for the well-being of its residents.

VEGETATION

There are four distinct vegetation zones in the basin, established by elevation and the corresponding levels of temperature and precipitation. Those are: Cropland, principal forest, upper-slope forest, and subalpine forest.

Cropland is principally on the valley floor and foothill slopes below elevation 1,000 feet. Most of that land has been cleared for agricultural, residential, industrial, and commercial uses. Agricultural land, partly irrigated, is used to produce crops ranging from hay and forage through small grain to fruit, nuts, and truck crops for canning and the fresh market. Remaining forest stands on the valley floor,

scattered and totalling less than one-third of the area, are principally of Douglas fir and hardwood and generally not commercially used.

The principal forest zone lies between elevation 1,000 and about elevation 4,000 feet. It includes areas on the slopes of the Cascade and Coast Ranges and the Calapooya Mountains. Coniferous forests cover most of the area. Douglas fir is the predominant species. Most of the principal forest zone is owned by the public and a few large timber companies.

The upper slope forest extends from the upper limit of the principal forest at 4,000 feet, to 5,000 or 6,000 feet. Most of the area is in public ownership. True fir and mountain hemlock stands cover a large part of the area, with rock outcrops, meadows, lakes, and lava beds interspersed. Upper-slope forests are widespread in the Cascades but exist only on Marys Peak, at the highest point in the Coast Range.

The subalpine forest, found only in the High Cascades, lies between 5,500 feet and timberline. Most of the area is in National forests, and has significant natural scenic and recreation values. Groves of subalpine fir, mountain hemlock, whitebark pine, and ground juniper are scattered amongst meadows, barren areas, and lakes.

R E S O U R C E S

The resource base of Willamette Basin is wide and varied, ranging from those elements natural and inherent in the basin to the economic, social, and cultural developments made by the people who reside there. Individual basic data and functional appendixes, as appropriate, provide detail and additional information in support of the following brief summary statements.

NATURAL RESOURCES

Willamette Basin's principal natural resources are its waters, lands, forests, fish and wildlife, and a climate which, together with those resources, provides a desirable environment for living, working, and playing. Mineral resources, as a basis for extractive industry, are relatively limited.

Water Resources

The total annually available water resource of the basin is generally in excess of present needs. Because of the seasonal climatic regimen, however, seasonal shortages and excesses create problems. The difference between minimum daily flows, in late summer, and major flood peaks, in winter, is marked. Those shortages and excesses provide both a need and an opportunity for water storage development.

Streams

Willamette River is the principal stream of the study area. It drains 11,200 of the 12,045 square miles in the area. Its principal tributaries--Middle Fork Willamette, McKenzie, Santiam, Molalla-Pudding, and Clackamas Rivers--rise in the Cascades. Most of the smaller tributaries--principally Coast Fork Willamette, Long Tom, Marys, Luckiamute, Yamhill, and Tualatin Rivers--rise to the south and west in the Calapooya Mountains and the Coast Range.

All streams not tributary to the Willamette drain directly to Columbia River. Of that group, Sandy River, rising in the Cascades, is the largest.

Runoff

Average annual runoff from study area streams totals more than 26 million acre-feet. Willamette River contributes nearly 24 million of that total. Table II-2 shows drainage areas and runoff averages for selected locations in the study area.

Streams of the Coast Range, Calapooya Mountains, and lower Cascade Range head at relatively low elevations and respond directly to the annual precipitation distribution. Average flows rise abruptly in October, peak in January, recede less rapidly until about the end of May, and reach annual lows in August or September. Calapooya Mountains and Coast Range streams have naturally very low flows in August and September.

Table II-2
Estimated average annual runoff at selected stations

Stream and Location	Drainage Area Sq. mi.	Runoff Ac.-ft.
Middle Fork Willamette River, near mouth	1,340	2,870,000
McKenzie River, near mouth	1,337	3,910,000
Santiam River, near mouth	1,790	5,940,000
Tualatin River, near mouth	710	1,080,000
Clackamas River, near mouth	936	2,680,000
Sandy River, below Bull Run Reservoir	440	1,800,000
Willamette River, at Springfield	2,030	4,180,000
Willamette River, at Albany	4,840	10,400,000
Willamette River, at Salem	7,280	17,000,000
Willamette River, at Portland, near mouth	11,100	23,900,000

In contrast, the flows of streams heading in the High Cascades rise less rapidly in the fall, peak in December and January, then subside gradually to the annual low in August or September. The rate of change of average flows is less than for streams heading at lower elevations, and sustained summer flows are larger. This reflects the effect of precipitation accumulating in an annual snow pack, and of runoff infiltrating permeable volcanic deposits in some headwater areas.

Ground Water

In addition to surface runoff, Willamette Basin has a large volume of water in natural underground storage. The quantity of water available at various locations ranges from meager in parts of the Coast Range to copious in parts of the valley floor and the Cascade Range. Because of remote location and rugged terrain, ground water stored in the volcanic aquifers of the High Cascades is not likely to be used in the foreseeable future. There is annual recharge, principally from precipitation, but the total amount is not definitely known. Estimates indicate that almost 2 million acre-feet annually might be added to the basin's "dependable" supply by use of ground water. Limiting factors, in addition to cost of development, include use in excess of recharge in some areas, naturally occurring mineralization (in some areas and at moderate depths), and pollution in a few instances.

At present, ground water sources provide about 40 percent of the irrigation water, 18 percent of the industrial water, 12 percent of the municipal water, and 95 percent of the rural domestic water used in the basin.

Other Considerations

In addition to runoff volumes and annual flow distribution patterns, other factors related to the water resource enhance its value and must be considered in plan formulation.

On the basis of a nation-wide comparison, the quality of flows in the Willamette Basin study area is very good. The exceptions, as shown in Appendix L, are seasonal and limited to the Portland harbor area and a few other locations. The surface waters are suitable for irrigation and, in general and with treatment, for municipal, industrial, and domestic use. The stream pattern makes water available, subject to seasonal variations in quantity and quality, for use in all parts of the basin. Suspended sediment loads are small and siltation of reservoirs is not a problem. All of the streams support fish life, and most are suitable for use by resident trout and anadromous fish. Pollution problems, generated by past misuse and abuse of the resource, are being solved or ameliorated in most of the basin under a set of State-adopted standards. Those standards are Federally-approved for that portion of

the river downstream from Willamette Falls at Oregon City. Thus, maintenance of water quality must be a consideration in plan formulation, and there is some opportunity for improvement.

The range of elevation, from the Willamette headwaters to Columbia River, and the accompanying range of stream slopes from precipitous to tidally affected, makes power generation and navigation uses possible in appropriate reaches. Because of the generally good quality of water and associated environment, and because of the wide range of conditions found, all forms of water-related recreation are enjoyed, and a considerable potential for such use remains unexploited.

Land Resources

General

The basin's 7.7-million-acre land area represents a varied resource. Ranging from near sea level to more than 11,000 feet in elevation, and from rich alluvial silts to volcanic outpourings and alpine peaks, it provides a basis for agriculture, forestry, and recreation as the three major industries. Forests cover about two-thirds of the basin. The remaining one-third is divided among agricultural uses and urban or intensive development uses.

Forest Lands

Of the five million acres of forest land in the basin, one-half is in public ownership and one-half is privately owned. Forest lands support the wood-products and tourist or recreation industries which, respectively, rank first and third in Oregon's economy.

About eight-tenths of the public land is in four National forests, principally in the headwaters of the Cascade Range tributaries. Almost two-tenths of the public land is public domain and Oregon and California Railroad revested lands administered by the Bureau of Land Management.

About four-tenths of the private forest land is in large ownerships of more than 5,000 acres each. A majority of the large private holdings are in the principal forest area; most of the small private holdings are on the valley floor.

Aside from some quarter million acres reserved as wilderness, almost all of the forest land is classified as commercial; that is, it is producing or capable of producing usable crops of wood, is economically available, and has not been withdrawn from timber harvest. Public forest lands, much of the large private holdings, and some of the small holdings are managed for increased production and multiple use.

A principal use of forest land is timber production. Commercial forest lands contain more than 25 billion cubic feet of growing stock and in the order of 150 billion board feet of saw timber. Most of the total is softwood, and most of the softwood is Douglas fir. The present annual harvest is in the order of 3 billion board feet. More than 400 primary wood-using industries convert the harvest to lumber, plywood, pulp and paper, and wood residue products such as chipboard. Appendix C contains additional details.

Forest lands also provide a substantial part of the environment for fish and wildlife and for recreational use. Appendixes D and K present detailed information on those aspects. Most of the runoff of the basin drains from forest land. Appendixes B and G, respectively, contain details of runoff and of the effect of forest management on quantity and quality of runoff. Forest lands, particularly on the valley floor, support a limited amount of grazing.

Agricultural Lands

Agricultural lands on the valley floor make up about three-tenths of the basin area and support Oregon's second-largest industry. They include farm timber land, grazing land, and cropland. About one-third of the farm timber land is managed by the owners as commercial woodlands. Grazing land is located principally in the transition zone between farm and forest, at the higher elevation and on the steeper slopes. Its production is low, but there is potential for considerable improvement with improved management.

Cropland makes up about 50 percent of the farmland. Of the total cropland, more than 240,000 acres are irrigated. Cropland generally is highly productive, but suffers in some areas from lack of drainage, flooding, and/or lack of water during the growing season. Nonetheless, the basin leads the Nation in the production of many seed crops. Also,

it supports a substantial livestock industry, and a large row crop and specialty crop industry which produces 14 percent of the Nation's processed snap beans, most of its superior quality sweet corn, and almost all of its filberts. The major economic contribution of the row and specialty crops comes from a relatively small total area, much of which is in the floodplain and irrigated.

Based on projected population and economic growth, as detailed in Appendixes C, F, and G, the land available for agriculture will be reduced by about one-fifth by the year 2020. The remaining land then will be expected to provide support for a population in the order of three times the present, and for the accompanying increases in overall economic development.

Fish and Wildlife Resources

General

As shown in Appendix D, fish and wildlife resources of the basin contribute substantially to both industry and outdoor recreation. The anadromous fish of the basin constitute a national, and to some extent an international, food resource which is harvested in the offshore and Columbia River commercial fisheries. All of the fish and wildlife resources, in their natural setting, are used or enjoyed in the recreation-tourist industry, which serves the State and part of the Nation and ranks third in the State's economy.

Fish Life

The basin's streams support both anadromous fish and warm- and cold-water resident fish. As of 1965, the total fish population was adequate to sustain annual use generally as follows:

Anadromous fish (commercial catch) 3 million pounds
Anadromous fish (sport fishery) 500,000 angler-days
Resident trout (sport fishery) 900,000 angler-days

In addition, the generally under-used warm-water game fish resource provides an annual average of 200,000 angler-days of use, substantially all from natural reproduction.

A part of the annual production of anadromous fish and resident trout is from natural spawning. Artificial propagation, however, provides annual average stocking totals in the order of 25 million juvenile anadromous fish and 5 million fingerling and catchable-size resident trout.

Wildlife

The available wildlife resource covers a wide variety, from upland game, migratory birds, small game, and furbearers to deer, cougar, bear, and elk. Of all these, only a relative few--deer, pheasant, and waterfowl--provide the basis for the largest share of the basin's wildlife recreation.

Except for a limited harvest of furbearing animals, the basin's wildlife resource is not used commercially. At present, many residents travel to other areas for their hunting recreation. For example, in 1965 only about 60 percent of the licensed resident hunters hunted within the basin, and some of the 60 percent also used other areas at times.

Game Commission records show a continuing decline in ability of the basin to support a wildlife resource which will satisfy the recreational hunting demand. Nonetheless, the resource still is important as evidenced by an annual average of about 310,000 hunter days of deer hunting with a harvest of almost 30,000 animals.

Mineral Resources

Willamette Basin mineral production amounts to slightly less than 40 percent of the State total and has an average annual value in the order of $20 million. Most of the production value is in sand, gravel, stone, and cement. Almost all such production is used locally for general construction and for roadbuilding and maintenance projects.

Sand and gravel deposits are the base for roughly one-half of the total mineral production value. The Division of State Lands regulates removal from streambeds, under a royalty fee program in the interest of revenue for the State school fund. Projections by the State Department of Geology and Mineral Industries point to a shortage of sand and gravel by the year 2000. Only in the immediate Portland area, where extensive commercial dredging has taken place, is there presently

a shortage of sand and gravel in the streambeds. In some areas, however, to avoid the cost of royalty payments to the State, gravel operators are purchasing and mining private lands in the floodplain.

Based on present knowledge, reserves and potential for metallic minerals are limited. For example, the total value of all production (mercury, gold, silver, copper, lead, and zinc) since 1900 is less than $3 million. Available lignite and sub-bituminous coal deposits are not fully explored and have been little used. No petroleum or natural gas reserves have been discovered.

Other Natural Resources

The basin's principal other natural resource is its overall environment--an intangible and variable compound synergized from climate, physiography, vegetation, water, land, air, and all forms of animal life. The importance of that environment to the residents is increased by the fact that, within easy travel distance in or adjacent to the basin, almost any desired environment for any occasion can be found. For the gregarious social individual or family there is group entertainment--mass recreational development, water spectaculars, salmon fishing in a hog line on the Willamette; for the loner, the nature lover, there is an opportunity to commune--on trails and streams and mountain peaks--with land and water and wildlife.

All told, the environment is a thing which makes it possible for basin residents to earn a living--and which makes living worthwhile and enjoyable for the majority. It is an asset enjoyed by basin residents, Oregonians, and tourists from much of the North American Continent. Plan formulation must deal carefully with environment if the basic study concept is to remain valid.

HUMAN RESOURCES

General

Willamette Basin's human resource has changed and increased greatly over the past one and one-half centuries. In 1829, the estimated population, almost all Indians, was reduced by epidemic from about 10,000 to 1,000 persons. The principal thrust of immigration and settlement began shortly thereafter, but by 1880 the total population still was

less than 100,000. Thus, the basin's present human resource, in both number and nature, is principally the product of events during less than a century.

Population

The present population of the basin is about 1.34 million persons, or about 70 percent of total State population. At present, and for all periods since 1910 except the 1950-60 decade, population growth rates exceed Pacific Northwest and National rates and equal those of some of the fastest growing regions of the Nation. Since 1960, the average annual rate has been 2.34 percent.

Almost three-quarters of the population is urban, and less than one-tenth of the nonurban population lives on farms. The principal concentration is in the Portland metropolitan area, with a population in the order of 0.8 million, at the northern end of the basin. Similar, but considerably smaller, concentrations exist in the Eugene-Springfield area near the southern end of the basin and at Salem in the middle subarea.

Ninety percent of the total basin population is located in those three concentrations. The remainder of the population is concentrated on the valley floor along the principal travel routes; all told, about nine-tenths of the urban population is located within 10 miles of Willamette River. There is little population in forested areas, and almost none on public lands in the forests.

CULTURAL AND SOCIAL RESOURCES

Willamette Basin has a major share of the State's population, income and development. Thus, its social and cultural environment is significant both within the basin and for the State as a whole. Its population yet reflects the pioneer background of many families and the liberal mix of races, philosophies, and religions furnished by in-migration in excess of natural population increase. The present growing trend to urbanization and industrialization, however, is modifying some of the individualism and self-reliance inherited from that background. There is a growing trend to community action and mass-oriented social and cultural development. At the same time, there is growing recognition

of the need for and value of outdoor recreation in the natural environment of woods and streams unmodified by development. Thus, its cultural heritage still is in part outdoor-use, do-it-yourself oriented but rapidly changing in scope and emphasis. The cut-out-and-get-out philosophy typical of the pioneering, conquering, and exploiting era is being erased and there is a growing consciousness of need for preservation and a developing tradition of wise resource use.

In 1965, the basin's institutions of higher education, including three major universities and a state college, had an enrollment of almost 70,000--more than five percent of the basin's population. The curricula covered the full range from education, music, and the liberal arts through science, theology, and law to technical and industrial arts, dentistry, and medicine. A wide range of churches, libraries, hospitals, and welfare and correctional institutions serve the needs of residents. Opera, music, and the arts provide social and cultural opportunity and diversion. The Oregon Museum of Science and Industry, located in Portland, provides a mirror for old principles and new developments in research and use of resources. County and State fairs bring rural and urban dwellers together in annual reunion to display and enjoy the products and progress of the basin in pleasant social surroundings. Community, social, and service clubs provide outlets for excess energies and opportunities for individual and public improvement.

Cultural resources also include the man-made or man-related features which enable one to reconstruct and, to a degree, relive events of the past. By so doing, one can develop an understanding and appreciation of man's struggles and their relationship to other elements of the environment. Willamette Basin is important in recent history because it was the first region of the Pacific Northwest to be colonized in the course of the westward movement. Historic sites in the basin trace the exploration, settlement, and development of the area since 1792. Events, people, and eras are represented in currently marked or developed areas. Houses, graves, trails, townsites, and institutions illustrate the kinds of sites found in this historic Pacific Northwest valley.

The human prehistory of the area, derived through the study of data obtained from archeological investigations, plays an important role in the understanding of the evolution of life in the basin. The majority

of Willamette Basin's archeological sites occur in the Willamette River flood plain though recent surveys and excavations indicate that additional sites may be discovered in the foothills and stream valleys.

Preservation of outstanding historic and archeological features will enable present and future generations to more fully understand and appreciate the total environment of the basin.

All told, the basin's social and cultural resources reflect the character of its people and serve it well, both in terms of its needs and by comparison with the State and Nation. Because of the changes, growth, and development which are yet in prospect, plan formulation must weigh social and cultural impacts of plan alternatives before a final selection is made.

E C O N O M I C D E V E L O P M E N T

GENERAL

Many developments have been made to use and control the basin's natural resources. These, as described in appendixes A through L, include transportation, utility, housing, industry, and water and land resource developments.

Portland, Salem, and Eugene, connected by Interstate Highway 5, two commercial airlines, and a main rail line, are hubs from which radiate land transportation routes. All of the valley is served by an excellent road system and most of it by branch rail lines. Portland is served by deep-draft intercoastal and foreign navigation lines, by barge lines on the Columbia, and by rafting of logs from points upstream to Corvallis in the Middle Subarea. In addition, pipe lines bring natural gas and petroleum products to the basin.

Electric power has been an asset in the basin since 1890 when the first long-distance transmission of alternating-current power in the United States was made in the Oregon City-Portland area at the north end of the basin. Use of electric power per customer now is the highest in the Nation, consistent with the overall high standard of living, relatively abundant supply, and power costs which are among the lowest in the Nation. An interconnected system of public and private generating plants and transmission lines, covering the Pacific Northwest, has made the region's power resources available as needed.

Housing and utility developments in the basin are generally adequate to serve the present needs of industry and the resident and tourist populations. Residences generally are of wood, reflecting the abundance of that resource. Because of the comparatively high level of personal income, and the relatively young age of most housing, homes generally are of good quality. More than 200 municipal water systems provide a supply in the homes of almost 90 percent of the population; the remainder are served by individual and group facilities. Sewerage systems, including waste treatment facilities, serve all of the cities and some adjoining urban areas. Some suburban and rurban areas are sewered and have treatment facilities.

The three principal industries, in order of economic importance, are forest, agricultural, and recreation. Appendix C shows details of those and other industries which overall resulted in a total personal income within the basin of more than $1.7 billion in 1950-51, rising to almost $2.8 billion in 1960-61.

BASE LEVEL OF DEVELOPMENT

Water and related land resource development in the basin includes both structures and nonstructural programs and measures. The structures involved are in part single-purpose, mostly non-Federal; and in part multiple-purpose, mostly Federal. Programs include all of those available on the national, or Federal, level and several developed in the basin or at State level to meet State and local needs.

Most of the existing development has been for flood control, drainage, and power generation. Also, there are developments for irrigation, navigation, municipal and industrial water supply, and recreation. Measures have been taken to improve water quality, by at-source pollution control; to preserve and enhance fish and wildlife resources; and to protect soils and watersheds.

The State Water Resources Board, working with other State agencies, has established programs for control and use of unappropriated natural flows. It has classified waters of individual streams as to highest and best use, and water rights may be issued only for such uses. For the protection of aquatic life and to minimize the effects of pollution, it has established minimum perennial streamflows below which future appropriations may not be made. The Board has also withdrawn from future appropriation both unappropriated natural flows and waters released from storage, as necessary to provide for specified uses such as fish life and recreation.

All of the base-level development serves present needs, although not in total, and can continue to function in the future. Some of the development, principally Federal reservoirs, provide substantial service in functional fields (fish and wildlife, recreation, and water quality improvement) not recognized by present authorizations.

Plan formulation studies considered the services that existing development could provide to meet projected needs, when operated as now authorized and with potential variation to provide improved overall service.

It also considered the possibility of justifiable physical alteration to elements of the base level of development.

Elements of the base level of development are summarized in the following text.

Storage Development

Of the total development summarized in this section, storage reservoirs, particularly those for multiple-purpose use, are a major part. Reservoir development generally is either Federal, or Federally assisted, for multiple-purpose use, or non-Federal for single-purpose power, irrigation, or water supply use. None of the existing, and only one of the authorized, Federal reservoirs have recreation as an authorized purpose. Nonetheless, all of the existing multiple-purpose reservoir projects include recreation facilities, and are heavily used for general recreation. Most also are heavily used by fishermen. One is used by waterfowl hunters. Similarly, all of the larger non-Federal reservoirs, except those in watersheds closed in the interest of municipal water supply, and several of the smaller ones are used for fishing and/or general recreation.

In total, the base level of existing, authorized, and assured storage development consists of 46 single- and multiple-purpose projects, each with usable capacity of 300 acre-feet or more, with an aggregate capacity of about 2.4 million acre-feet, plus about 2,400 small reservoirs, ponds, and pits. Table II-3 shows status, usable capacity, installed generating capacity, and purposes served. Map II-2 shows the location of those reservoirs with 1,000 acre-feet, or more, of usable capacity.

The base system of storage, subsequently used as discussed in Part IV to evaluate residual needs, includes 20 multiple-purpose reservoirs with total usable capacity of about 2.2 million acre-feet.

It should be noted that the base level of storage development, as described herein, excludes more than 2,400 farm ponds, pits, and reservoirs with individual capacities less than 300 acre-feet. The principal use of those small storages is for irrigation, with fishing, fire protection, and general recreation as important secondary uses to many farm families.

Table II-3
Existing, authorized, and planned Willamette Basin reservoirs with 300 acre-feet or more of usable storage capacity

Subbasin and Reservoir	Stream Name	Usable Capacity Ac.-ft.	Installed Gen. Cap. KW	Auth. Purpose or Use 1/
Coast Fork:				
Cottage Grove	Coast Fk.	30,000	-	FC,N,I
Dorena	Row R.	70,500	-	FC,N,I
Subtotals		100,500		
Middle Fork:				
Lookout Point	Middle Fk.	349,000	120,000	FC,N,I,P
Dexter (Rereg.)	Middle Fk.	4,800	15,000	P
Hills Creek	Middle Fk.	249,000	30,000	FC,N,I,P
Fall Creek	Fall Cr.	115,000	-	FC,N,I
Oak Ridge millpond 2/	-	380	-	Indust.
Subtotals		718,180	165,000	
McKenzie:				
Cougar	S. Fk. McKenzie R.	165,000	25,000	FC,N,I,P
Strube (Rereg.) 3/	S. Fk. McKenzie R.	3,000	39,500	P
Blue River	Blue River	85,000	-	FC,N,I
Gate Creek 3/	Gate Creek	50,000	-	FC,N,I
Weyerhaeuser 2/	-	420	-	Indust.
Walterville 2/	McKenzie R.	345	8,000	P
Trail Bridge 2/	McKenzie R.	2,750	10,000	P
Carmen 2/	McKenzie R.	300	80,000	P
Smith 2/	Smith R.	9,900	-	P
Subtotals		316,715	162,500	
Long Tom:				
Fern Ridge	Long Tom R.	109,000	-	FC,N,I
Carrol 2/	Noti Cr.	355	-	I
Subtotals		109,355	-	
Santiam:				
Detroit	N. Santiam R.	340,000	100,000	FC,N,I,P
Big Cliff (Rereg.)	N. Santiam R.	2,400	18,000	P
Green Peter	M. Santiam R.	333,000	80,000	FC,N,I,P
Foster	S. Santiam R.	33,600	20,000	FC,P
Cascadia 3/	S. Santiam R.	145,000	-	FC,N,I
Holley 3/	Calapooia R.	90,000	-	FC,N,I
Will. Nat. Lumber (Wiley Cr.		375	-	Indust.
Company 2/ (-		300	-	Indust.
Subtotals		944,675	218,000	

Table II-3 (Cont'd)

Subbasin and Reservoir	Stream Name	Usable Capacity Ac.-ft.	Installed Gen. Cap. KW	Auth. Purpose or Use 1/
Coast Range:				
Haskins 2/	Haskins Cr.	410	-	M&I
North Fork 2/	N. Fk. Rock Cr.	307	-	M&I
Thompson 2/	Bark Cr.	362	-	R
Clemens 2/	-	800	-	Indust.
Dallas 2/	Rickreall Cr.	1,200	-	M&I
Subtotals		3,079	-	
Pudding:	N O N E			
Tualatin:				
Scoggins 3/	Scoggins Cr.	53,000	-	FC,I,M&I,R, F&W,WOC
McKay Cr. 4/	McKay Cr.	19,300	-	FC,I,M&I,R,F&W
Rock Cr. 4/	Rock Cr.	3,800	-	FC,I,M&I,R,F&W
Subtotals		76,100		
Clackamas:				
Timothy Lake 2/	Oak Grove Fk.	61,650	-	P,R
Oak Grove 2/	Oak Grove Fk.	546	51,000	P
North Fork 2/	Clackamas R.	6,000	38,400	P,R
Faraday Lake 2/	-	550	34,450	P
River Mill 2/	Clackamas R.	770	19,050	P
Subtotals		69,516	142,900	
Columbia:				
Lake Oswego 2/	-	5,100 5/	522	P,R
Sandy:				
Trillium Lake 2/	Mud Cr.	353	-	R
Bull Run Lake 2/	Bull Run R.	12,300	-	M&I
Bull Run No. 1 2/	Bull Run R.	30,100	-	M&I
Bull Run No. 2 2/	Bull Run R.	21,000	-	M&I
Roslyn Lake 2/	-	970	21,000	P
North Fork 2/	N. Fk. Bull Run	1,030	-	M&I
Subtotals		65,753	21,000	
Willamette Basin Totals		2,408,973	709,922	

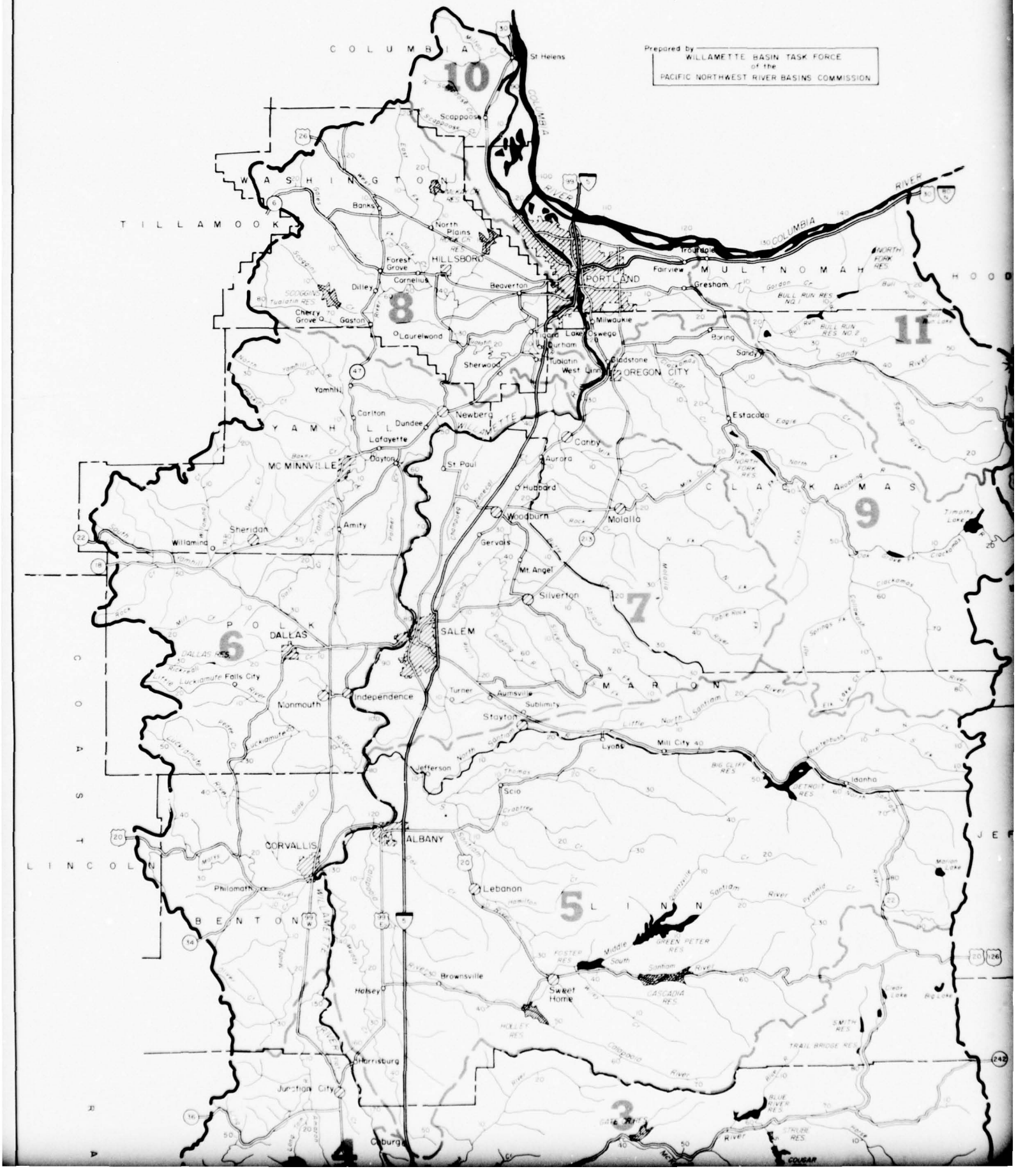
1/ FC, flood control; N, navigation; I, irrigation; P, power; R, recreation; M&I, municipal and industrial; F&W, fish and wildlife; WQC, water quality control. All existing Federal reservoirs are used for recreation, even though not so authorized.

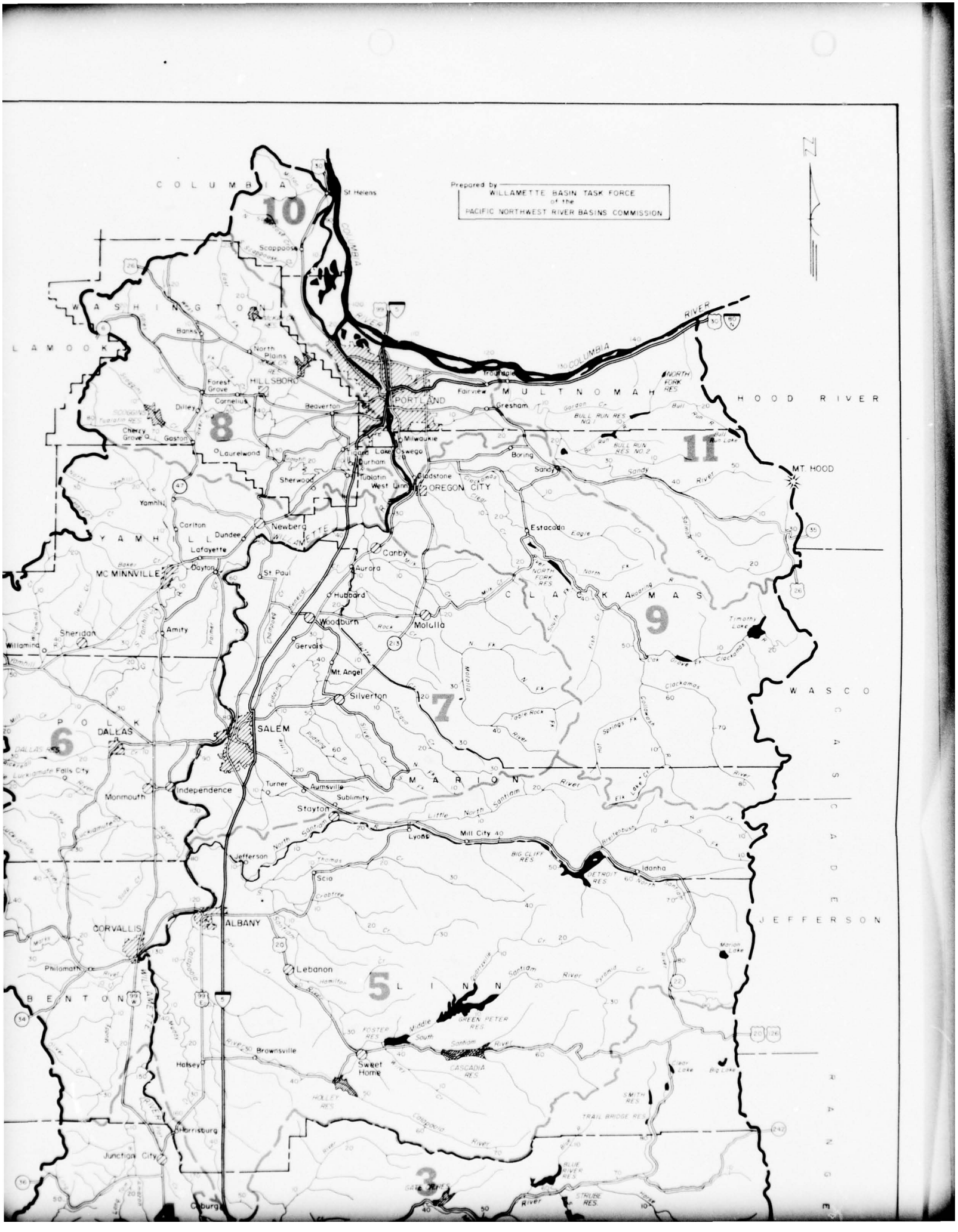
2/ Non-Federal development.

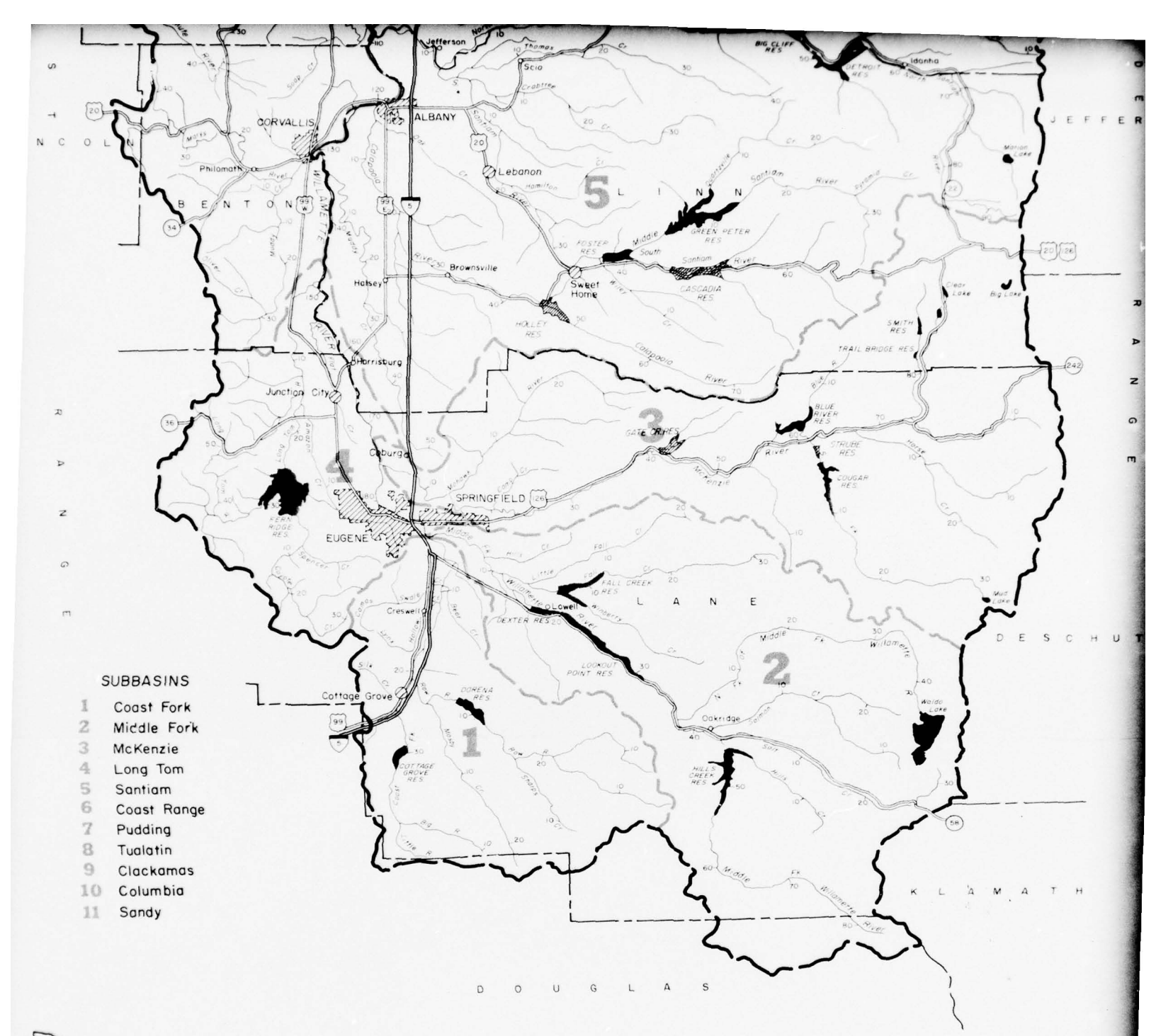
3/ Authorized Federal project.

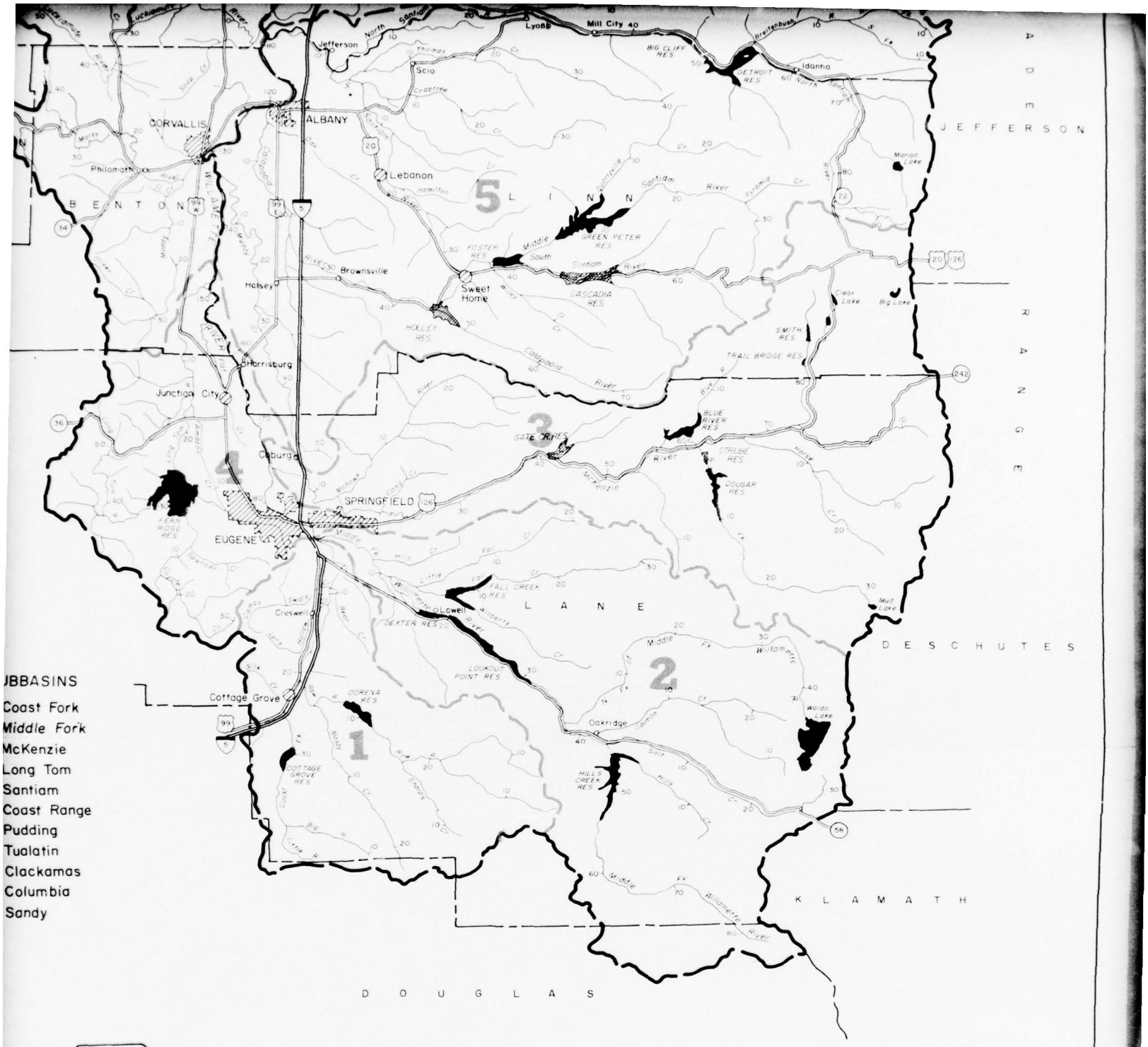
4/ Being studied under separate authorization; considered to be part of base system.

5/ Water diverted from out-of-subbasin Tualatin River.


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COLUMBIA
WASHINGTON
TILLAMOOK
YAMHILL
POLK
BENTON
LINCOLN
COAST
CLACKAMAS
MARION
LINN
JEFFERSON
MULTNOMAH
HOOD
10
8
6
9
7
5
3
11
St Helens
Scappoose
Banks
North Plains
Forest Grove
HILLSBORO
Cornelius
Dilley
Beaverton
PORTLAND
Fairview
Troutdale
Gresham
Cherry Grove
Gaston
Laurelwood
Tualatin
Sherwood
West Linn
Milwaukie
Lake Oswego
Boring
Sandy
Gladstone
OREGON CITY
Yamhill
Carlton
Newberg
Dundee
Lafayette
McMINNVILLE
Dayton
St Paul
Estacada
Canby
Aurora
Hubbard
Woodburn
Molalla
Sheridan
Willamina
Amity
Gervais
Mt Angel
Silverton
SALEM
DALLAS
Falls City
Monmouth
Independence
Turner
Aumsville
Sublimity
Stayton
Lyons
Mill City
Jefferson
Scio
Idanha
CORVALLIS
ALBANY
Philomath
Lebanon
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Coburg
COLUMBIA RIVER
BULL RUN RES
NO 1
NO 2
NORTH FORK RES
BIG CLIFF RES
DETROIT RES
GREEN PETER RES
FOSTER RES
CASCADIA RES
HOLLEY RES
TRAIL BRIDGE RES
BLUE RIVER RES
SMITH RES
SCOGGIN
Tualatin RES
DALLAS RES
COUGAR


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N
COLUMBIA
WASHINGTON
CLATSOP
TILLAMOOK
YAMHILL
POLK
BENTON
LINN
MARION
CLACKAMAS
MULTNOMAH
HOOD RIVER
WASCO
JEFFERSON
DESCHUTES
CROOK
10
8
6
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7
9
11
3
St Helens
Scappoose
Banks
North Plains
Forest Grove
HILLSBORO
Cornelius
Dilley
Beaverton
Cherry Grove
Gaston
Laurelwood
PORTLAND
Fairview
Troutdale
Gresham
Milwaukie
Oswego
Lake Oswego
Durham
Tualatin
West Linn
OREGON CITY
Boring
Sandy
MT. HOOD
Sherwood
Yamhill
Carlton
Newberg
Dundee
Lafayette
McMINNVILLE
Dayton
Canby
Aurora
St Paul
Hubbard
Woodburn
Molalla
Estacada
Eagle Cr.
Timothy Lake
Sheridan
Amity
Willamina
Gervais
Mt. Angel
Silverton
DALLAS
SALEM
Monmouth
Independence
Turner
Aumsville
Sublimity
Stayton
Lyons
Mill City
Jefferson
Scio
Idanha
CORVALLIS
ALBANY
Philomath
Lebanon
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Coburg
Marion Lake
Big Lake
Lost Lake
Santiam River
North Santiam River
South Santiam River
Willamette River
Clackamas River
Sandy River
Columbia River
Little North Santiam
Mollala River
Pudding River
Molalla River
Table Rock Fk
Hot Springs Fk
Elk Lake Cr.
Eagle Cr.
Timothy Lake
Clear Lake
Marion Lake
Big Lake
Lost Lake
Foster Res.
Green Peter Res.
Cascadia Res.
Holley Res.
Big Cliff Res.
Detroit Res.
North Fork Res.
Bull Run Res. No. 1
Bull Run Res. No. 2
Smith Res.
Trail Bridge Res.
Blue River Res.
Strube Res.


CORVALLIS
ALBANY
Philomath
Lebanon
Scio
Jefferson
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Coburg
SPRINGFIELD
EUGENE
Creswell
Lowell
Cottage Grove
Oakridge
Idanha
BENTON
LINN
LANE
DOUGLAS
JEFFERSON
DESCHUTES
KLAMATH
CASCADE RANGE
COAST RANGE
1
2
3
4
5
SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy
PORTLAND
Study Area
SALEM
B
EUGENE
A
C
SUBAREAS
A Upper
B Middle
C Lower
NOTE: RESERVOIRS SHOWN HAVE A USABLE STORAGE CAPACITY OF 1,000 ACRE-FEET OR MORE.
EXISTING RESERVOIR
ASSURED RESERVOIR
MAP II-2
WILLAMETTE BASIN STUDY
OREGON
EXISTING and ASSURED
RESERVOIRS
1969
SCALE IN MILES



NOTE: RESERVOIRS SHOWN HAVE A USABLE STORAGE CAPACITY OF 1,000 ACRE-FEET OR MORE.

EXISTING RESERVOIR

ASSURED RESERVOIR

MAP II-2

WILLAMETTE BASIN STUDY

OREGON

EXISTING and ASSURED RESERVOIRS

1969

SCALE IN MILES

Fish and Wildlife

Fish

Fish facilities consist of developments as features of storage projects and under fishery programs discussed in Appendix D and summarized in Part V of the appendix. Overall, fish life programs have been the principal basis for maintenance of existing trout and anadromous fisheries.

The most important manmade facilities are the partially completed new fishladder at Willamette Falls, which provides improved access for anadromous fish to all basin streams, and fish hatcheries. There are seven salmon and steelhead hatcheries, six operated by the State and one by the Fish and Wildlife Service, and three trout hatcheries operated by the State. Three of the salmon and one of the trout hatcheries were constructed, and are operated by the State, with Federal funds as mitigation for losses occasioned by reservoir construction. An essential factor in operation of the Willamette Falls fishladder is the withdrawal from future appropriation, by the State Water Resources Board, of the initial 430 cubic feet per second of unappropriated waters released from Corps of Engineers reservoirs for navigation purposes.

Appendix D identifies and discusses more than 30 programs related to fish life and fisheries. Some are experimental; some include research and investigation. Overall program effectiveness cannot be determined. As noted in Part V, however, indications now are that fish production programs, for anadromous fish, will be dramatically effective.

Two study programs which warrant special mention are those on downstream migrant protection at Willamette Falls and on water requirements for fish transportation, spawning, and rearing. The former, by Oregon State Game Commission and related to effective use of the new fishladder, has resulted in recommendations to the industrial complex at Willamette Falls. Under those recommendations, present major losses of juvenile anadromous fish would be reduced or eliminated. The latter study also was by the Game Commission in coordination with OSWRB. It provided a basis for adoption, by OSWRB, of perennial minimum flows on a seasonal rather than an annual basis. The information obtained is reflected in Addendum A to Appendix D.

Wildlife

Wildlife facilities are those established under Federal and State laws and programs. None are mitigation features of existing projects.

Appendix D identifies more than 30 Federal, State, and private wildlife programs. Part V of this appendix describes program elements of the plan. Major program responsibility rests with public agencies--Oregon State Game Commission, U. S. Forest Service, U. S. Bureau of Land Management, and U. S. Bureau of Sport Fisheries and Wildlife. Most of the programs are reasonably well established and are providing definite and valuable results.

The principal facilities which have been provided under Federal and State laws and programs are discussed in Appendix D. Included are refuges, a State-owned game farm near Corvallis, and wildlife management areas. Refuges include several established on private land under State law, and three small national wildlife refuges, primarily for protection of dusky Canada geese. When complete, those refuges will total about 10,700 acres in area. The State now owns or controls more than 19,000 acres in five wildlife management areas, of which the largest is the 10,963-acre Sauvies Island Game Management Area. Private development consists of a few areas, principally for waterfowl shooting.

Flood Control

Flood control developments, or aspects of existing development, include: (1) the flood control aspects of multiple-purpose reservoirs; (2) private, Federal, and private-Federal channel improvement works; and (3) facilities and improvements provided under programs related to control of floods and reduction of flood damages.

Existing and authorized multiple-purpose reservoirs listed in Appendix E provide a total of about 2 million acre-feet of flood control space. Runoff is controlled, generally up to the 100-year-frequency level, from about 3,200 square miles, or less than 30 percent of the Willamette River drainage area. As shown in Appendix E, the existing storage projects provided, in the 1964 flood alone, damage reduction

benefits more than equal to total project cost. However, a significant flood problem remains unsolved.

Channel improvement works include those by the Corps of Engineers; those under programs of the Department of Agriculture; and those, of undetermined total magnitude, by private entities. Included are channel enlargement, realignment, and clearing; levees; and revetments for channel stabilization.

Channel improvements constructed or authorized to be constructed by the Corps of Engineers include work in all those categories, under various general continuing and specific authorizations. Principal elements include:(1) five completed projects under Section 205 of the 1948 Flood Control Act, as amended; (2) an almost-completed channel stabilization project totalling almost 90 miles in length and involving about 200 locations on Willamette River and major tributaries; (3) the completed Amazon Creek channel and a number of other authorized channel projects, including Pudding River and Johnson Creek; and (4) authorized flood walls and levees for the Portland area. Also, there is an authorization, under which some work has been done, for channel clearing and snagging, and a considerable amount of more-or-less temporary improvement accomplished under various emergency authorizations. Of the authorized but unconstructed channel improvements several, including Johnson Creek and Pudding River, have not been constructed for lack of legally required local sponsorship.

Facilities constructed under Department of Agriculture programs involve both Federal and local funds. By January 1969, soil and water conservation districts had completed: (1) 875 miles of minor bank protection and channel improvements; and (2) 1,360 miles of open drains. Structural measures of five small watershed projects completed, underway, and assured under PL 83-566, include: (1) 122 miles of channel improvement, (2) 2 miles of lined flood channel, (3) 1 mile of levee, and (4) four flood gates.

Programs for control of floods and reduction of flood damage are discussed in Part V. Included are: (1) the small project and emergency

programs of the Corps of Engineers; (2) the small watershed projects program of the Department of Agriculture, under PL 83-566 (specific early-action projects under that program are described in Part V), and USDA emergency programs; (3) the locally accomplished program of flood plain use regulation, aided by flood plain information programs cooperated in by State and Federal agencies and consistent with the land use plan and zoning requirements of SB 10 as adopted by the State legislature in 1969; (4) the flood and streamflow forecasting program of the U. S. Weather Bureau and the Corps of Engineers; and (5) the flood control aspects of overall land measures and watershed protection programs. The flood plain use regulation and streamflow forecasting programs are essential adjuncts and complements to structural works for control of floods.

Local regulation of flood plain use is aided and supplemented by a flood plain information program conducted in cooperation by C of E, SCS, and USGS and coordinated by OSWRB. Flood plain studies are completed or underway in all of the basin's counties. Lane County and Washington County have flood plain zoning ordinances, and other counties are expected to follow suit. Senate Bill 10, above-mentioned, provides that if, after December 31, 1971, there are lands that are not subject to ORS 390.640 or to a comprehensive land use plan and zoning ordinances, the Governor shall take action to prescribe, amend, and administer such plans and zoning regulations. This will insure the accomplishment of needed regulation.

Streamflow forecasting, by the Portland River Forecast Center, operated by the Weather Bureau and Corps of Engineers, provides information on forecast flood events. This facilitates operation of storage reservoirs, and Federal, State, and local action to prepare for flood emergencies, on both Willamette and Columbia Rivers.

Irrigation

Irrigation development increased from about 1,000 acres in 1911 to roughly 244,000 acres in 1965. Development in recent years has been rapid. Existing, authorized, and assured irrigation development is shown in Table II-4.

Development to date has been private, either alone or with the assistance of Federal and State programs. Farmers of the basin, assisted

by industry and Oregon State University, pioneered in the use of sprinkler irrigation, and present application is almost entirely by that method. About 60 percent of the present development uses surface water. Federal storage in existing reservoirs is available, at a nominal charge, through a program administered by USBR. As of 1966, there were 31 contracts under that program, for 5,780 acre-feet to serve 2,690 acres of land.

Irrigation programs, discussed in Appendix F and in Part V of this appendix, cover a broad range of activities, and include Federal and State agency activities. Activities involved include research and education, financing, soil surveys, planning assistance, and land treatment. Agencies involved at State level on a regulatory or advisory basis include OSWRB, the State Engineer, the State Soil and Water Conservation Commission, the State Department of Agriculture, and Oregon State University. Federal agencies involved on a planning and participation basis include the Bureau of Reclamation, Soil Conservation Service, Agricultural Stabilization and Conservation Committee, Extension Service, and Farmers Home Administration.

Table II-4
Irrigation development

Category and Subbasin	Acreages, by type of project		
	Cooperative	Individual	Totals
Existing:			
Coast Fork	0	3,470	3,470
Middle Fork	0	2,090	2,090
McKenzie	200	7,620	7,820
Long Tom	0	20,730	20,730
Santiam	14,200	40,610	54,810
Coast Range	150	43,820	43,970
Pudding	8,500	64,250	72,750
Tualatin	0	19,090	19,090
Clackamas	0	6,330	6,330
Columbia	0	10,760	10,760
Sandy	0	1,840	1,840
Subtotals	23,050	220,610	243,660
Authorized and Assured:			
Long Tom	3,000	1/	3,000
Tualatin	20,000	1/	20,000
Subtotals	23,000		23,000
Basin Totals	46,050		266,660

1/ Information not available.

From Table II-1 and Tables IV-3 through 13 of Appendix F.

Land Measures and Watershed Protection

These program developments are for the purpose of conservation, development, utilization, and maintenance of lands and related resources. They are practiced nationwide, and apply to all lands. For this study, however, land measures are related most directly to agricultural lands and watershed protection most directly to forest lands. Overall, those practices are multiple-purpose, with beneficial effects on fish and wildlife, water supply, water quality, flood control, and recreation, as well as on agriculture and forestry.

Although small in area, some of the highest soil erosion rates in the basin occur during development of urban, industrial, and residential areas when construction activities remove vegetative cover and leave bare soils exposed to winter rains. Some erosion is inevitable during periods of active disturbance, but many of the erosion control practices used successfully on farm and forest lands can help prevent erosion in those disturbed areas. Little has been accomplished to date, but communities and local governments can help prevent erosion and sediment damage by incorporating land-clearing and earth-moving provisions in their land use plans and zoning regulations.

The accumulated permanent improvement under land measures programs, as detailed in Appendix G, includes:

a. More than 450 miles of levees, floodwater diversions, channel improvements, and channel stabilization for flood control and damage reduction.

b. About 7,200 miles of ditches, tile drains, and ditch stabilization for drainage.

c. More than 350-grade stabilization and water-control structures.

In addition, more than 1.3 million acres of erosion control practices involving contour farming, cover cropping, crop residue use, and green manuring have been applied; more than 30,000 acres of wetlands and wildlife habitat have been developed for waterfowl and upland game; nearly 700 ponds are stocked and managed for fishing. Planting, reseeding, pruning, and harvest cutting is practiced on nearly 230,000 acres of small farm woodlands and nearly 25,000 acres of cropland have been converted to more suitable uses such as woodland, wildlife, recreation or pasture.

Watershed protection measures on forest lands include fire protection, research, management, restoration practices, road building, fish and wildlife habitat improvement, recreation development and many others in addition to timber harvest. These measures are carried out by the State of Oregon, the U. S. Forest Service, and the Bureau of Land Management, as well as by private owners. They cover about 3.1 and 2.5 million acres of public and private lands, respectively.

No complete summary of accomplishments or developments under these programs is readily available. About $12 million, or about $2.50 per acre, is required annually for forest land measures to conserve soil and water.

Municipal and Industrial Water Supply

Municipal and industrial water supply facilities include some of the storage reservoirs listed earlier, water treatment facilities, and water conveyance and distribution systems. Development has been principally by municipalities and by industry, using storage, surface water, and ground water. Total use, including rural-domestic, now averages about 370 million gallons per day, with a peak demand rate about twice that amount.

Table II-2 of Appendix H shows that there were 78 independent municipal water systems in 1965. Ground water was the source for more than one-half of those systems, but supplied only about 10 percent of the people served. Three major service-area systems--Portland, Salem, and Eugene--served nearly 80 percent of the 1.1 million people using municipal systems. Information as to the total investment in those systems, or in rural-domestic installations, is not available.

Both State and Federal programs contribute, directly or indirectly, to municipal and industrial water supply developments. The State Engineer and the U. S. Geological Survey (USGS) make ground water investigations, and maintain streamflow data, which assist in defining location and extent of available supplies. The Water Standards program, administered by the State's Department of Environmental Quality (formerly Oregon State Sanitary Authority), and the Water Resources Activities Program of FWPCA contribute to quality of water supplies. Watershed protection programs aid in assuring supplies of good quality water.

Programs of the Farmers Home Administration and the Department of Housing and Urban Development provide planning funds and construction loans for community development. Programs of the State Board of Health and the U. S. Public Health Service assure that the consumer receives a safe and wholesome product through the public water systems.

Navigation

Navigation facilities in the form of a deep-draft ship channel serving Portland, a multiple-lift lock at Willamette Falls, and a shallow-draft channel maintained upstream to Corvallis serve the basin. Those facilities were constructed or improved, and are maintained and operated, by the Corps of Engineers. Also, the Port of Portland dredged a 20-foot channel from Ross Island Bridge, in Portland, upstream to Lake Oswego, to accommodate deep-draft barges handling limestone. All of those facilities are described in Appendix I.

In addition, the private sector and public bodies have provided, adjacent to navigable reaches of the Willamette, about 100 piers and wharves to serve commercial shipping. Seventy-nine are located in the Portland harbor area. Also, there are a large number of public and private facilities for launching and mooring of recreational water craft, and many log dumps and similar special-use facilities.

Traffic through Portland Harbor includes all manner of local, coastal, and worldwide shipping, both shallow- and deep-draft. Upstream from Portland, traffic is shallow-draft, principally tugs, barges, log rafts, and pleasure craft. Most of the traffic upstream from Willamette Falls is log rafts moving downstream, and pleasure craft.

Programs which have assisted existing navigation development are limited to those of OSWRB for preservation of streamflows. Storage and release of water to supplement natural low-water flows and assist in providing depths adequate for navigation is an authorized function of all existing C of E storage reservoirs in the basin. The Board's programs for Willamette River protect both minimum natural flows and flows from storage released for navigation, up to totals equal to the flow required to supplement authorized open-river navigation improvements.

Power Generation

Willamette Basin is served by in-basin and out-of-basin generating and transmission facilities in the Pacific Northwest Federal-private-public power system. The basin's power requirements are almost one-fourth of the regional load, and it is strongly dependent upon out-of-basin sources for electric power.

Total installed generating capacity in the basin is about 938,000 kilowatts, of which about three-fourths (718,000 kilowatts) is at 35 existing hydroelectric plants. The remainder is at 23 thermal plants. More than one-half (408,000 kw) of the hydroelectric installation is at eight Corps of Engineers projects. Authorized additions to the Cougar project, including Strube reregulating dam and generating installation, would add about 40,000 kilowatts of installed capacity.

Except for Federal projects, hydroelectric projects must be licensed by the State Engineer and FPC. Prior to issuance of a license, for all projects of more than 100 theoretical horsepower, the Water Resources Board must determine that the project would be in the public interest. For projects with less than 100 theoretical horsepower, the Board may request the State Engineer and FPC to defer licensing until it has reviewed the proposal and determined the public interest.

Certain Federal agencies also have direct water resources site preservation functions in connection with waterpower development potentials. Power site classifications are established by the U. S. Geological Survey under the basic authority of the Organic Act of March 3, 1879 (20 Stat. 394), which created the Geological Survey. Power site reserves are established under the authority of the Act of June 25, 1910 (36 Stat. 847). The Federal Power Commission can effect withdrawals under the authority of the Federal Power Act of June 10, 1920 (41 Stat. 1075). There also are other authorities relating to more specific conditions. With some duplication, withdrawals presently in force in Willamette Basin total about 107,700 and 25,400 acres for the USGS and FPC, respectively. The lands classified as potential water resource development sites probably would now be privately owned except for the protection afforded by the earlier classification. These protected lands could contribute significantly to the environmental management program. Those reserves and classified sites which fall within areas listed herein for management for preservation of environment are shown in Table IV-15.

Recreation

Willamette Basin has a substantial recreation resource, or potential. About 4.4 million acres are in classifications suitable for outdoor recreation. There are about 106,000 acres of water surface on streams wider than one-fourth mile and on lakes and reservoirs of more than 40 acres. Also, there are more than 550 small natural lakes with areas of less than 10 acres; ponds and small reservoirs on more than 2,000 farms provide about 3,200 acres of water surface. Table II-5 summarizes camping and picnicking facility developments.

Table II-5
Camping and picnicking facilities, 1963
by subarea

Subarea	Number of Sites	Number of Family Units			
		Picnic	Tent	Trailer	Total
Upper	257	1,275	744	99	2,118
Middle	250	3,434	589	43	4,066
Lower	329	4,452	664	112	5,228
Totals	836	9,161	1,997	254	11,412

From Table II-6 Appendix K.

In addition, about 135 moorages and public and private boat-launching ramps provide access to the basin's streams, lakes, and reservoirs.

Development of facilities has been at all levels--private, local, State, and Federal. The Division of Parks of the State Highway Department, most of the cities, and all of the counties, have park and recreation programs. Each of the Federal land management agencies has a program of providing access to and facilities in recreational areas. The State has a Willamette River Park System program, under State law, which provides funds on a cost-sharing basis to local interests. It is also currently assisted with funds from the Land and Water Conservation Fund program administered by BOR. As of June 1969, almost 300 acres with about 2 miles of river frontage had been acquired as a part of the system. Also, the State has enacted legislation requiring statewide zoning. That legislation is expected to give impetus to a combination

of flood plain use regulation and recreation use and development on flood plain lands.

Many special areas of unique natural, scenic, scientific, and historical interest have been set aside, as listed in Table II-6.

Part V, under the heading Early-Action Elements, discusses recreation programs in more detail.

Table II-6
Classified special areas

Type and Name	Areas, in Acres	
	Total	Net within Basin
Wildernesses:		
Diamond Peak Wilderness	35,440	16,200
Mt. Hood Wilderness	14,160	2,320
Mt. Jefferson Wilderness	99,632	66,174
Mt. Washington Wilderness	46,655	38,030
Three Sisters Wilderness	196,708	136,833
Subtotals	392,595	259,557
Classified Recreation Areas:		
Little Crater Geological		5
Lowder Mountain Geological		140
Mt. Hood Recreation		30,720
Quaking Aspen Swamp Botanical		240
Rebel Rock Geological		700
Yankee Mountain Scenic		490
Waldo Lake Recreation		32,600
Columbia Gorge Recreation		28,787
Subtotal		93,682
Classified Unique and Natural Areas:		
Gold Lake Bog Natural		463
H. J. Andrews Experimental Forest		15,000
Olallie Ridge Natural		720
Wildcat Mountain Natural		1,000
Subtotal		17,183
Total Classified Acreage		370,422

From Table II-3, Appendix K.

Water Pollution Control

Basin communities are complying with orders from the State Department of Environmental Quality (DEQ - formerly Oregon State Sanitary Authority) to provide secondary waste treatment facilities. Also, industries using the river for waste disposal are making progress toward compliance with orders intended to bring water quality up to standards recently adopted by the State of Oregon. Community-installed secondary treatment provides for the removal of at least 85 percent of the biochemical oxygen demand (BOD) and for sterilization of the effluent.

Table II-7 summarizes the 1965 level of municipal and industrial waste-treatment development; because of rapid progress in that field, it does not cover all present development.

Table II-7
Summary of waste treatment facilities
1965

Category and type	No. of Plants	Population Served	Population Equivalents Untreated	Population Equivalents Discharged	Efficiency Percent
Municipal:					
Secondary	66	323,125	1,026,720	299,550	78 2/
Primary 1/	8	36,350	140,950	96,880	32 2/
Lagoon	8	5,390	5,410	940	83 2/
Other	9	1,850	1,850	1,050	43 2/
Subtotals	91	366,715	1,174,930	328,420	72
City of Portland	1	370,000	385,000	3/	3/
Total municipal	92	736,715	1,559,930	328,420	79
Industrial:					
Pulp and paper	9	-	4,491,400	1,074,060	76 4/
Food products 5/	13	-	134,550	4,100	97
Forest products	20	-	22,950	9,690	58
Miscellaneous	5	-	38,350	29,090	25
Subtotals	47	-	4,687,750	1,116,940 5/	76
Basin totals	139	736,715	6,247,680	1,445,360 5/	77

1/ *Under orders for improvement to secondary level*
2/ *Being upgraded to at least 85 percent BOD removal*
3/ *Primary treatment, discharge to Columbia River*
4/ *During summer low-flow period; accomplished by temporary withholding in lagoons, land application, and barging to Columbia River.*
5/ *In addition, as shown in "Willamette River Basin Water Quality Control and Management," January 1967, 720,000 PE of untreated wastes are reduced to 207,000 PE of discharged wastes by treatment in municipal plants.*

From Tables II-1 and II-4, Appendix L.

Flows released from Federal reservoirs for the authorized purpose of navigation make up from one-half to two-thirds of the total low-water flow of Willamette River at Salem. Those flows, and the OSWRB minimum streamflow protection programs, Addendum F, are essential to provision and maintenance of good water quality. Watershed protection and management programs provide at-source improvement in water quality.

Basic Water Resource Data Collection

In addition to all the other programs, the U. S. Weather Bureau, the U. S. Geological Survey, the Soil Conservation Service, and the State of Oregon collect, compile, and publish snow survey, precipitation, runoff, and other basic meteorologic and hydrologic data. All told, streamflows are recorded, and data are published, for about 90 stations on basin streams.

Meteorological data collected and compiled include temperature, precipitation, snow-pack depth and water content, evaporation, wind, relative humidity, sunshine and cloudiness, hail, and tornadoes. Appendix B describes the data collection systems.

Daily Streamflow Forecasting

The U. S. Weather Bureau, Environment Science Services Administration (ESSA), Department of Commerce, has the basic responsibility for the preparation and public issuance of daily river and streamflow forecasts in the Pacific Northwest Region (Columbia River Basin and adjacent coastal and interior basins).

To provide operational reservoir control streamflow forecasts, the River Forecast Center, U. S. Weather Bureau, ESSA, and the North Pacific Division, Corps of Engineers, combined manpower resources and computer capability in the Cooperative Columbia River Forecast Unit, located in Portland. The Unit utilizes observed hydraulic and meteorological data and Weather Bureau predictions of rainfall and temperatures as input to a computerized Willamette River Basin model. The computer program, embodying specific storage operating schedules, generates daily river and streamflow forecasts for Willamette Basin.

Seasonal and Residual Water Supply Forecasting

The U. S. Soil Conservation Service, Department of Agriculture, and the U. S. Weather Bureau, ESSA, Department of Commerce, prepare and issue seasonal water supply forecasts in the Pacific Northwest Region (Columbia River Basin and adjacent coastal and interior basins).

Water supply forecasts are derived from an analysis of snow water equivalent, precipitation and soil moisture, and are used by agricultural, municipal, industrial, and governmental interests.

BASIN PROBLEMS, NEEDS AND POTENTIALS

INTRODUCTION

Plan formulation must recognize what the basin is and strive to delineate the development which is desired for the future. This involves recognizing its present and projected problems and striving to satisfy its projected needs. Solutions for satisfaction of needs must be based on wise use of all available resources--on the potentials of the basin and, in some cases, on the related potentials of and developments in the state and region in which it is located. In planning for wise use, consideration must be given to all available alternatives.

This part of Appendix M discusses problems, needs, and potentials in terms of: (1) the public involvement which provided a significant input to knowledge of problems and needs, and the subsequent formulation of the basin plan; (2) the project functions recognized as appropriate for accomplishment by State and Federal agencies; (3) environmental and social considerations; and (4) legal and institutional considerations, all as pertinent to the adopted concepts, goals, and objectives outlined in Part I. Local views as to problems and needs, as expressed at four public hearings at the start of the study, are mentioned as appropriate to each category of need.

P U B L I C I N V O L V E M E N T

A significant and essential aspect of the determination of problems, needs, and potentials, and of the subsequent formulation of a plan, was the high degree of public involvement realized. The principal elements of public involvement are discussed in the following text.

OREGON STATE WATER RESOURCES BOARD

In addition to providing chairmanship for the Task Force, the Board (OSWRB) cooperated with other State agencies in studies of the Upper, Middle, and Lower subareas of Willamette River Basin. Each of those studies was preceded by public hearings to obtain data about public views as to water and related resource needs and potentials. The transcripts of those hearings, together with the Board's basin reports, have been used throughout the study as a source of information as to public needs and desires.

Also, and perhaps most important of all from the public involvement standpoint, the Board employed a Field Representative during Fiscal Year 1965 to conduct a year-long program of liaison with local governments, industries, groups, and individuals. That work was done under a planning grant from the Housing and Home Financing Agency, under Section 701 of the Housing Act of 1954.

The Field Representative personally met and discussed water and related resource problems, needs, potentials, and plans with a wide range of people. These included leaders of water and resource-related groups and organizations; city mayors, managers, recorders, planners, and superintendents; county commissioners, planners, and other officials; banking representatives; chamber of commerce presidents, managers, secretaries, and committee chairmen; news media owners, managers, editors, publishers, and working press representatives; and many others, totalling in all about 665 persons. In addition, he addressed 38 group meetings, with a total attendance of more than 1,500 persons. Those people represented all parts of the basin, were from all walks of life, and had interests in all phases of water and related resource preservation, development and use.

Data obtained during and generated by the Field Representative contacts were used throughout the study.

WILLAMETTE BASIN PROJECT COMMITTEE

The public involvement phase of study activities was enhanced in effectiveness by the existence of a Willamette Basin-wide organization of long standing, the Willamette Basin Project Committee. The Committee is a quasi-public organization, with suborganizations in each county in Willamette River Basin. It operates with the financial support of those counties. Its county suborganizations include committees on all functional aspects of water and related land resources discussed in this appendix. Its membership represents all of the basin area, and its actions reflect the views of basin residents on the total environment in which they spend their lives.

The Committee has provided continuing support for--and liaison among--Federal, State, and local governments; agencies; groups; and individuals. Throughout the study it provided for widespread dissemination of information about the study, study activities, and the need and opportunity for public involvement. In support of public involvement, it acted as a sounding board for public opinion as to resource use, control, development, and preservation.

During the course of the study, the Committee held eight well-publicized and well-attended annual meetings, with Task Force participation, at locations throughout the basin. Task Force and agency participation included presentation of progress reports on the study and discussion, in open question-and-answer sessions, of items of interest to those in attendance. Proceedings of each meeting, including text of the Task Force presentation, were published by the Committee and distributed to all parts of the basin. Also, following Task Force presentation of a preliminary plan in August 1968, the Committee printed and distributed widely both the proceedings of the meeting and copies of the plan summary.

Finally, both during and after the liaison work of OSWRB, the Executive Secretary of the Project Committee met with and assisted local committees in the following areas:

South Yamhill River Basin, Yamhill County
Chehalem Creek Drainage, Yamhill County
North Yamhill River Basin, Yamhill County

Luckiamute River Basin, Polk County
Thomas Creek Basin, Linn County
Calapooia River Basin, Linn County
Molalla-Pudding River Basins, Clackamas and Marion Counties
Marys River Basin, Benton County

In each of those basins, landowners met and selected a committee to further the development, use, and preservation of basin resources, according to the desires of all concerned. In order to be aware of the needs and desires of their people, the committees in North and South Yamhill, Chehalem, Luckiamute, Thomas, Molalla-Pudding, and Marys River areas made door-to-door canvasses of landowners in the area. Those canvasses provided inventories of expressed individual needs, which were tabulated and used to make known the needs of the areas.

Continued contact between the Committee's Executive Secretary and the landowner's committees in each of the areas listed provided a continuous liaison between the Task Force and its agencies, on the one hand, and representatives of substantially all of the landowners in all of those areas on the other. Most of the committees have designated the Willamette Basin Project Committee to look after their interests, and the Secretary has so acted.

WILLAMETTE BASIN SUBCOMMITTEE
OREGON ASSOCIATION OF SOIL AND WATER CONSERVATION DISTRICTS

The subcommittee is composed of concerned local people representing different geographical areas of the basin. It was organized in March 1965 to assist local Soil and Water Conservation District (SWCD) boards in setting up information and planning meetings and to provide guidance and council to the USDA basin planning personnel and other agencies as requested during the basin-wide comprehensive study. Soil and Water Conservation Districts are legal subdivisions of the State established in accordance with provisions of the Soil and Water Conservation District law.

The committee assisted in setting up about 100 local meetings where project proposals and alternative possibilities for resource development in watersheds were discussed with the people directly concerned.

Those meetings were held under the sponsorship of local SWCD's working with Water Control Districts where organized, local steering committees, and in some cases assisted by the County Technical Action Panel (TAP).

Local landowners and operators, county commissioners, city officials, and agency personnel were represented. Attendance was generally very good with 60 to 80 people being present at many of the meetings.

The subcommittee provided a vehicle for substantially increasing the involvement of the local people and their understanding of the problems and potentialities for developing the resources of their area. The basin-wide study, because of this, has received increased attention and understanding from local groups and local agencies of government.

The subcommittee also was of importance in developing and gauging local interest in guiding the USDA party in the selection of those projects which warranted further investigation and consideration for development in the next 10-15 years.

OTHER INVOLVEMENT

In addition, the Task Force and its various agencies met with many groups and discussed study aspects pertinent to individual areas in the basin study area. Such meetings ranged from the upper McKenzie area to the Sandy Subbasin. Included were groups such as the McKenzie River Chamber of Commerce, the McKenzie Flyfishers, a citizen's group of more than 200 interested in recreation on Fern Ridge Reservoir, county and subbasin committees along the east and west sides of Willamette Valley, the Washington County Court and planning staff, and city officials of Troutdale in Sandy Subbasin.

Also, at the end of the study, when this appendix was in draft form, the Task Force arranged for review and comments by the newly-staffed Oregon Environmental Council. The Council's views and comments will be used as guidance in completing the subsequent agency reports. Additional significant input has been made by the Upper Willamette Resource Conservation and Development organization, by the Small Watersheds Committee of the Willamette Basin Project Committee, and by many others throughout the course of the study.

SUMMARY

In summary, the Task Force and its agencies enjoyed the benefits of a higher degree of widespread public involvement in, and contribution to, this study than to any other study of which they are aware. That involvement has provided for the Federal and State agency participants in the study a broad base of knowledge about the basin and the needs and desires of its people. It has provided for the local people an opportunity to know about and become participants in the study process. That widespread public knowledge, involvement, and participation has added materially to the breadth and depth of the study, and to the validity and general acceptability of the resulting basin plan. It will be continued, on an agency-public basis, as the necessary ensuing agency studies are made to implement the plan subsequently described herein.

FUNCTIONAL CONSIDERATIONS

GENERAL

Unresolved problems and unsatisfied needs exist in each of the project functional fields recognized by the Congress. Projections contained in Appendix C - Economic Base, and the nine functional Appendixes, D through L, indicate a continuing increase in intensity of problems and magnitude of needs. Also, the functional appendixes, each in terms of the single function considered, show the known potentials for solving problems and meeting needs expressed therein. The material that follows in this section is a summary based on the detailed data in those appendixes.

FISH AND WILDLIFE

Fish and wildlife are basic resources which, over the years, have suffered a reduction in amount--and sometimes quality--of habitat. As a consequence, fish and wildlife populations generally have been reduced concurrently with a continuing increase in demand. The problems, needs, and potentials pertaining to each resource are discussed herein only as related specifically to formulation of plans for water and related land resources projects. For additional details, including recommendations for research, mitigation, management, and programs as a solution to problems now existing or projected, please refer to Appendix D, Fish and Wildlife.

Fish Life

Total Needs

The basic goal for the fish resource is stated in Part IV of Appendix D. That goal is to conserve and enhance the fish habitat and manage the resource in such a way that future demands on the resource may be satisfied to the greatest possible degree. Adoption of that goal is on the basis that, as additional supply is provided, additional demand will be created; in other words, that a demand will exist, in the combined commercial and sport fishery, for at least as many fish as can possibly be produced in the basin. As one tool for use in planning for the realization of that goal, the fishery agencies have estimated

conservative levels of total demands, for the years 1980, 2000, and 2020, for anadromous and resident fish.

Table III-1
Projected annual demand 1/ for fish for sport and commercial uses

Species and Use	Number of Fish		
	1980	2000	2020
Sport use:			
Spring chinook salmon	88,000	121,000	179,000
Fall chinook salmon	141,000	194,000	287,000
Coho salmon	63,000	87,000	129,000
Winter steelhead trout	8,000	11,000	16,000
Summer steelhead trout	88,000	121,000	179,000
Trout	2,800,000	3,800,000	5,500,000
Warm-water	900,000	1,200,000	1,500,000
Commercial use:			
Spring chinook salmon	177,000	242,000	359,000
Fall chinook salmon	424,000	581,000	861,000
Coho salmon	254,000	348,000	515,000
Winter steelhead trout	4,000	5,000	8,000
Summer steelhead trout	44,000	61,000	90,000

1/ On the basis of maintenance of present level of fisherman success; however, the present level is less than the administratively established maximum legal catch limit and far less than the level desired by fishermen, as indicated by statements at public hearings.

From Tables III-1, III-2, and III-3, Appendix D.

Additionally, and more specifically applicable to plan formulation, Appendix D, Addendum A, summarizes, for the entire basin: (1) existing summer flows that have produced the present anadromous fish populations, and the sources of those flows; (2) the escapement potential with those flows and continuation of 1965 fishery management and water quality control practices and programs; (3) optimum flows, with quality criteria and related considerations, from the fishery standpoint; and (4) the resulting additional escapement which could be realized if optimum flow conditions were provided.

Unmet Needs

Projected unmet needs for anadromous and resident fish to be harvested in the sport and commercial fisheries are summarized as follows:

Table III-2
Projected unmet need for sport and commercial fisheries

Species	Number of Fish Annually		
	1980	2000	2020
Spring chinook salmon	97,000	174,000	349,000
Fall chinook salmon	186,000	62,000	435,000
Coho salmon	107,000	190,000	399,000
Winter steelhead trout	2,000	2,000	10,000
Summer steelhead trout	119,000	119,000	243,000
Trout	900,000	1,900,000	3,600,000
Warm-water	360,000	660,000	960,000

From Tables III-5 and III-6, Appendix D.

Problems

Problems involved in satisfying unmet needs will remain, in general, as at present. The principal problems detailed in Part III of Appendix D are: (1) reductions in flow, resulting principally from increased consumptive use; (2) temperature increases, and other loss of water quality; (3) loss of spawning and rearing habitat, and access thereto; (4) toxic effects of pesticides and herbicides; and (5) lack of access to streams for sport fishing. The first three problems apply particularly to anadromous and resident cold-water fish, for which projected demand is shown to exceed the quantity expected to be supplied. For warm-water game fish, however, the principal problem will be provision of adequate and appropriately distributed access to fishing area.

Overall, adequate funding for needed activities of each of the fish and wildlife agencies will be a major problem.

Potentials

So far as warm-water game fish are concerned, the waters of the basin offer sufficient habitat, and natural reproduction is expected to provide a supply equal to projected demands. For anadromous and resident cold-water fish, on the other hand, the potentials for increased natural production are shown in Appendix D to be less than the conservatively projected demand.

During the study period there was a substantial change in the estimated potentials for artificial production of anadromous fish, and indications that estimates of natural production could be realized.

That change came about because of developments which took place or which had been proven effective since the start of the fish life study. Those developments include: (1) the introduction of the Oregon moist pellet as a standard diet at anadromous fish cultural stations, and continued proof of its superiority in terms of increased production; (2) initial successes in pond rearing of hatchery-produced juvenile anadromous fish, and increased returns of adult fish therefrom; (3) the success of initial upstream-passage facilities at Willamette Falls and continued progress toward a complete installation; (4) the considerable progress in pollution control under the State's program for water quality maintenance and improvement; and (5) the development of a water recycling system for fish hatcheries.

In view of those developments, and assuming continued availability of present levels of flow, potential exists for accelerated fish production, to the extent of increasing future levels of fisherman success and possibly accommodating some demand from outside the basin.

Even with the increased potential as outlined above, however, there remains additional potential which could be developed by provision of augmented flows of good quality. The optimum flow levels are those shown in the Addendum to Appendix D. Additional study apparently will be required to evaluate the benefits associated with provision of those flows.

Wildlife

Problems and Needs

Wildlife needs are for the preservation and enhancement of the resource. Included are needs for the provision of maximum harvestable numbers of game species, preservation of all desirable native wildlife forms, and maintenance of a dynamic ecological balance. The principal problems associated with those needs are the consequences of an increasing population and economic development, with resulting increasing demand and generally dwindling habitat. Details are presented in Appendix D.

Hunter demands exceed hunting use of the basin's resources. A part of the reason may be environmental rather than based on abundance of species; for example, a resident of the basin may wish to combine hunting for deer, pheasant, or duck with a vacation in the open space and clear, dry air of central or eastern Oregon. Nonetheless, the difference between projected hunter-days of use and total projected demand for hunter-days is a measure of the unsatisfied demand in the basin. Total projected demands, available uses, and unsatisfied demands for three future periods are summarized as follows:

Table III-3
Projected annual hunter-days of wildlife use and demand

Item	Hunter-days, in thousands		
	1980	2000	2020
Total Demand	2,486	3,553	4,539
Total Use 1/	1,079	1,570	1,907
Unsatisfied Demand	1,407	1,983	2,632

1/ *Based on continuation of present trends, with more efficient management.*

From Tables III-7 and III-8, Appendix D.

The foregoing demand figures are conservative, in that projected future success ratios are less than at present. Public opinion, as expressed at initial hearings, favors increased game populations and higher success ratios, so long as game damage to crops can be prevented or mitigated. With adequately increased wildlife population, the success ratio probably would improve enough to attract additional hunter use.

Potentials

The principal potentials for wildlife enhancement lie in the existence of a wide range of lands and waters which could be acquired, managed, and improved to provide wildlife habitat and public access. In some cases multiple benefits could be derived from actions beneficial to wildlife. Appendix D details the available potentials and, in some cases, shows estimates of costs and benefits.

FLOOD CONTROL

The term flood control implies the reduction or prevention of flood damages, both present and future, and the realization of increased use of the land resource. Needs for damage prevention are presented herein, in summary form. Both present and future needs are predicated on the existence of a reference level of flood control development, or base flood-control system. That system consists of existing and authorized reservoirs, channel improvement and stabilization, watershed management, flood forecasting and warning, and floodplain use regulation elements. Those elements are a part of the existing development described in Part II, Basin Description, of this appendix. The overall system of flood control elements is described in Part II of Appendix E. Appendix E also shows total flood control needs, and the extent to which those needs are met by the reservoirs of the base system.

Problems and Needs

The basic need is to eliminate present and future flood damages, or reduce them to the minimum practicable level. At the same time, there is a need to make possible the maximum practical use, for all purposes, of the potentials represented by the floodplain; that is, the areas subject to inundation by floods. Problems associated with serving those needs include: (1) a shortage of suitably located and economically feasible sites for storage control of flood runoff; (2) conflicts between water-control and water-use functions of multiple-purpose storage projects; (3) project impacts on existing resources; (4) lack of local understanding of, and willingness and ability to comply with, requirements for local cooperation; (5) difficulty of providing, and realizing full use of, information on floodplain use regulations and forecasted flood events; and (6) maintenance of vegetative cover in watersheds to help stabilize runoff rates and reduce downstream sedimentation. Also, there is a need for channel improvements to facilitate reservoir operation for flood control.

Unmet Needs

Monetary flood damages generally are categorized as agricultural, industrial, and community-based. In addition, there are damages to, and

reductions in, the environmental and esthetic values of the basin, peace of mind of residents, and other nonmonetary evidences of unmet needs for flood control. Substantially all categories of monetary damage are projected to increase through the year 2020 for all subbasins. From a hydrologic standpoint, the existence of damages reflects a need for flow and stage reductions; the projected monetary damages and losses indicate the general severity of need.

Tables IV-1 and IV-2, respectively, of Appendix E illustrate needs for stage and discharge reduction, and the accompanying unmet needs for storage and runoff control. Both tables are based on control, to bankfull or nondamaging stage, of a flood of 100-year frequency. That level of control was selected for illustrative purposes only; plan formulation was on the basis of attaining a maximum level of control consistent with concepts and ground rules outlined in Part IV - Plan Formulation.

Strong local desire for additional damage prevention was expressed at initial public hearings. The severity of unmet flood control needs is shown by projected average annual flood damages with no change in the reference level of projects and programs.

Table III-4
Average annual flood damages

Year	Projected Average Annual Damages, $1,000,000			
	Agricultural	Industrial	Community	Total
1965	2.4	0.2	2.8	5.4
1980	2.9	0.4	3.8	7.1
2000	3.7	1.0	6.4	11.1
2020	5.1	2.6	12.6	20.3

From Table III-1, Appendix E.

Available Potentials

Available potentials include structural and nonstructural measures. Included in the structural category are potential new projects and both physical and operational modifications to existing projects. It should be noted that a significant part of the structural potential consists of sites for development of multiple-purpose storage; control of floods

and reduction of flood damages would be aspects of the multiple benefits from use of that potential.

Structural

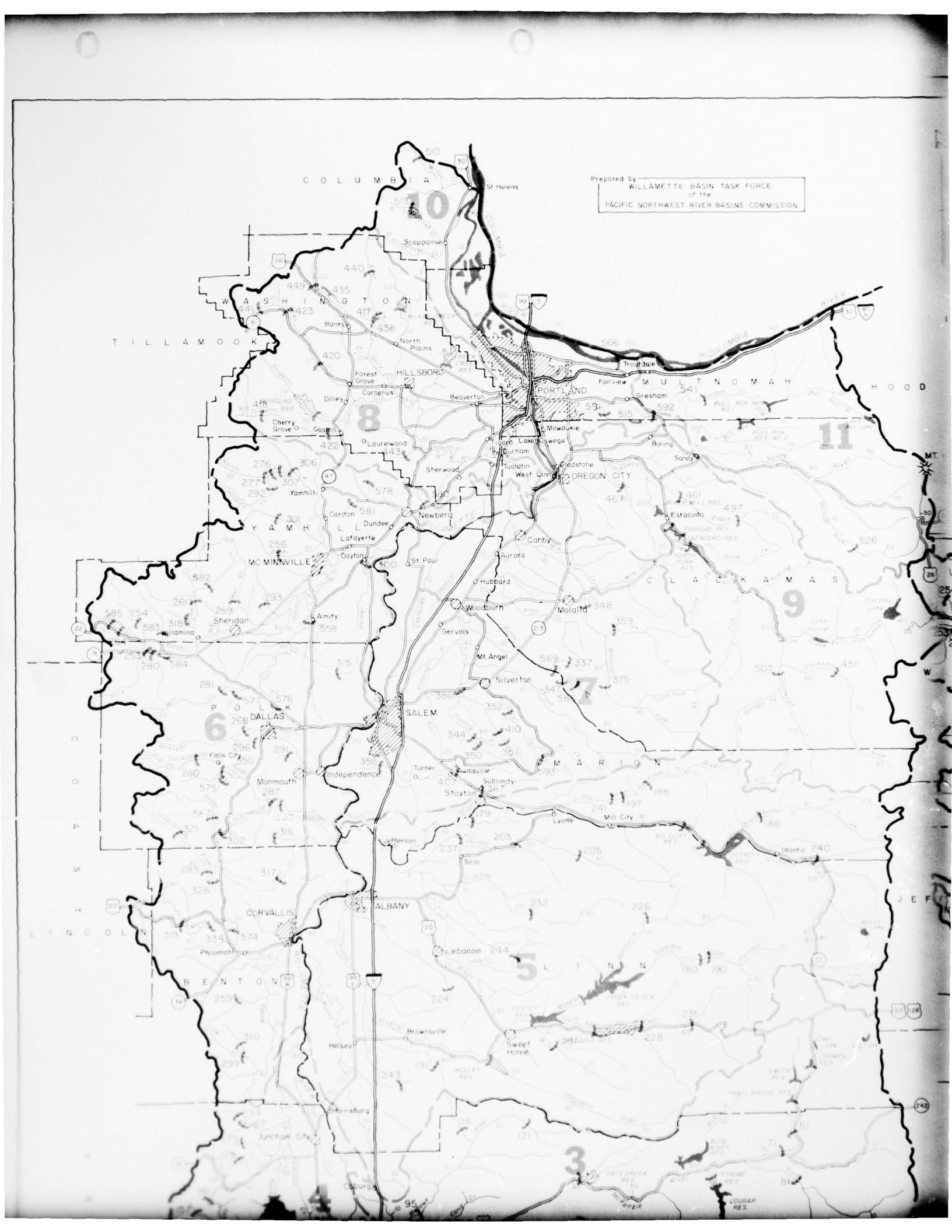
The structural potential is highlighted by the existence of about 600 storage sites which might be developable for multiple uses. Those with the greatest apparent potential for such development are shown on Map III-1. Included are potentials within the size range appropriate to the PL 83-566 program of the Department of Agriculture and the size range usually considered by agencies of the Departments of Army and Interior. Obviously, potential developments at some of the sites and combinations of sites must be considered alternative one to the other, as well as alternative to other structural and nonstructural measures and environmental preservation.

In general, structural modification potentials consist of opportunities to raise dam and gate structures to provide more storage capacity, or to add gates on ungated spillways to provide for controlled use of surcharge storage space. Potentials for operational modification for flood control would exist principally where additional storage units might be integrated with existing storage.

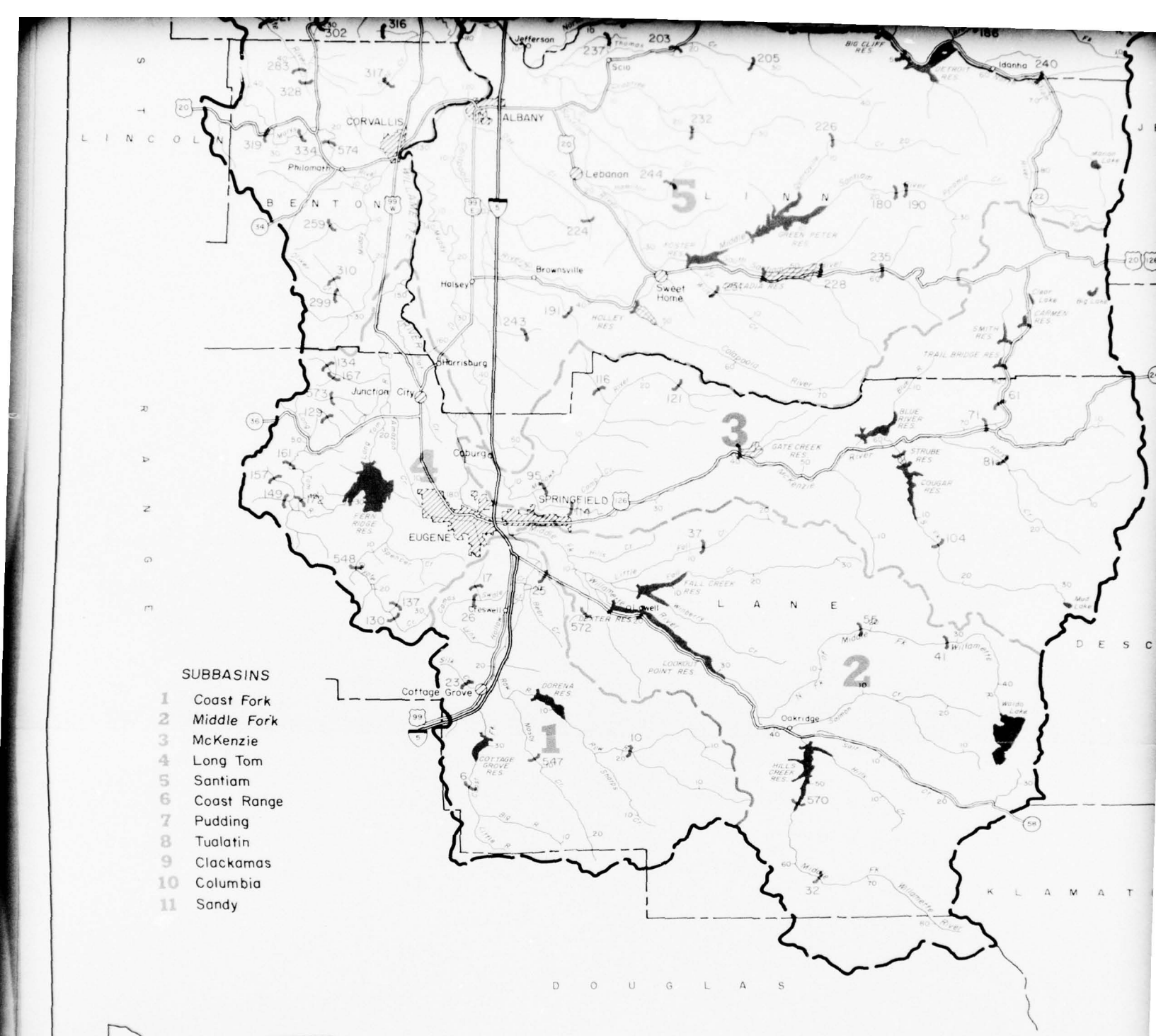
Substantially all floodplains involve some degree of potential for flood control and damage reduction by single-purpose local works. Such works include levees, channel enlargement and realignment, and channel stabilization. Existing single-purpose flood control projects have some potential for areal expansions, and for modifications to provide a higher degree of service. Most of the stream reaches with potential for structural measures involve environmental, fish and wildlife, and recreational assets and potentials which require consideration in planning for flood control.

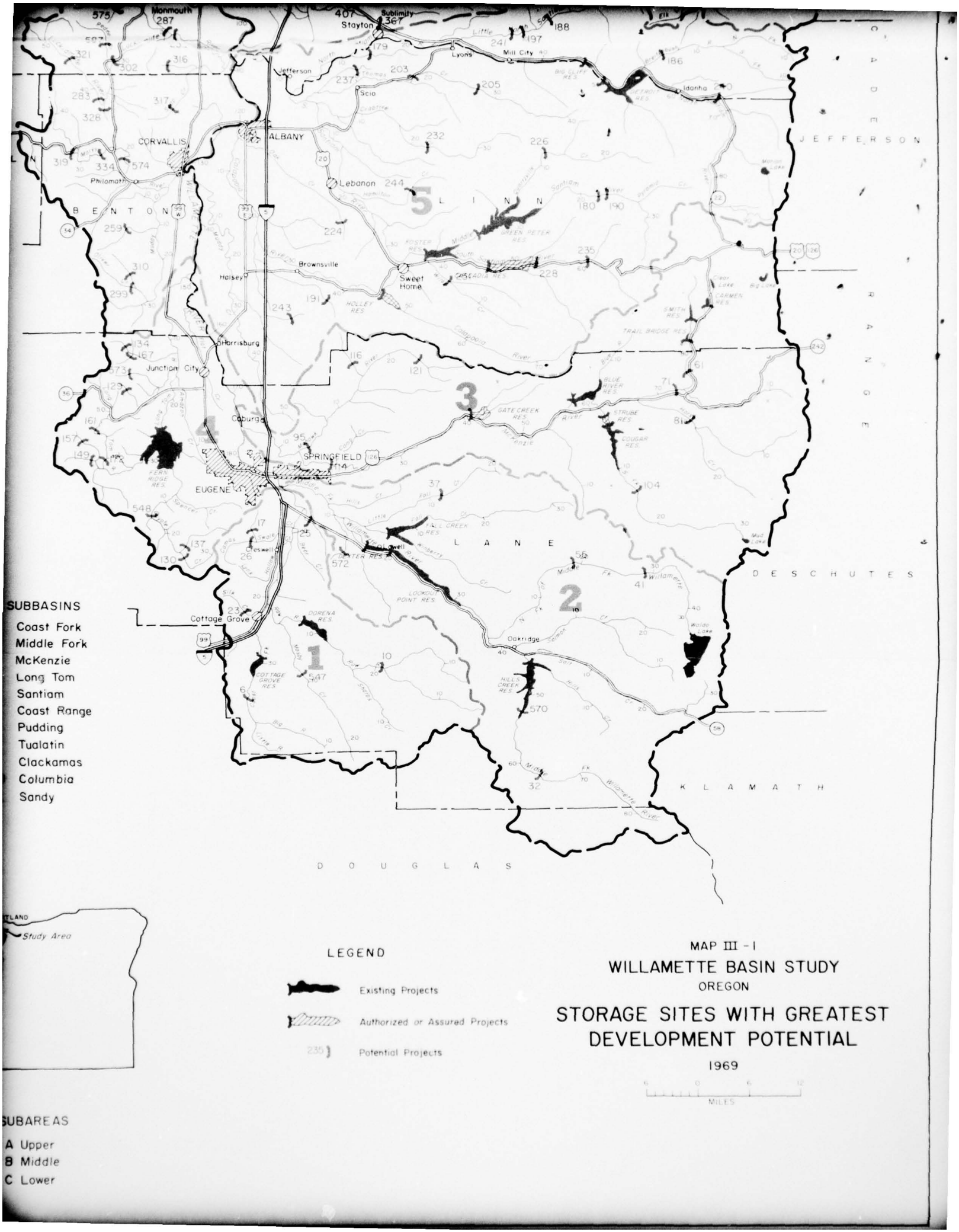
Nonstructural

The basin's nonstructural flood damage prevention potential is a compound of two elements. One consists of entities--individuals, groups, and local governmental units--with power under State Law to manage individual and collective use and development of the flood plain. The other consists of informational programs--flood plain management


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CLACKAMAS
MULTNOMAH
HOOD
JEFF
St Helens
Scappoose
Banks
North Plains
Forest Grove
HILLSBORO
Cornelius
Dilley
Beaverton
PORTLAND
Troutdale
Fairview
Gresham
Cherry Grove
Gaston
Laurelwood
Tigard
Lake Oswego
Durham
Milwaukie
Boring
Sandy
Sherwood
Tualatin
West Linn
Gladstone
OREGON CITY
Yamhill
Carlton
Newberg
Dundee
Lafayette
Dayton
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Canby
Estacada
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SALEM
Falls City
Monmouth
Independence
Turner
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Scio
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LANE
DOUGLAS
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Cornelius
Dilley
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Gaston
Laurelwood
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OREGON CITY
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Troutdale
Fairview
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Milwaukie
Boring
Sandy
Estacada
MT. HOOD
Canby
Aurora
St. Paul
Hubbard
Woodburn
Gervais
Mt. Angel
Silverton
Molalla
Sheridan
Amity
Willamina
DALLAS
SALEM
Falls City
Monmouth
Independence
Turner
Jefferson
Scio
Stayton
Sublimity
Lyons
Mill City
Idanha
CORVALLIS
ALBANY
Philomath
Lebanon
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Coburg
SPRINGFIELD
Cascade Range


CORVALLIS
ALBANY
Philomath
Lebanon
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Coburg
SPRINGFIELD
EUGENE
Cottage Grove
Oakridge
Jefferson
Scio
Idanha
Detroit Res.
Big Cliff Res.
Green Peter Res.
Foster Res.
Hills Creek Res.
Lookout Point Res.
Dexter Res.
Fall Creek Res.
Blue River Res.
Gate Creek Res.
Trail Bridge Res.
Smith Res.
Cougar Res.
Strube Res.
Carmen Res.
Big Lake
Cleawox Lake
Mud Lake
Waldo Lake
Row River
Dorena Res.
Cottage Grove Res.
Holley Res.
Fern Ridge Res.
LINCOLN
BENTON
LINN
LANE
DOUGLAS
DESC
KLAMAT
SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy
PORTLAND
Study Area
SALEM
B
EUGENE
A
LEGEND
Existing Projects
Authorized or Assured Projects
235 Potential Projects
MAP III - I
WILLAMETTE BASIN STU
OREGON
STORAGE SITES WITH GR
DEVELOPMENT POTEN
1969
MILES
SUBAREAS
A Upper
B Middle
C Lower


SUBBASINS
Coast Fork
Middle Fork
McKenzie
Long Tom
Santiam
Coast Range
Pudding
Tualatin
Clackamas
Columbia
Sandy
SUBAREAS
A Upper
B Middle
C Lower
Study Area
LEGEND
Existing Projects
Authorized or Assured Projects
Potential Projects
MAP III - 1
WILLAMETTE BASIN STUDY
OREGON
STORAGE SITES WITH GREATEST DEVELOPMENT POTENTIAL
1969
MILES
ALBANY
CORVALLIS
EUGENE
SPRINGFIELD
Lebanon
Sweet Home
Brownsville
Halsey
Harrisburg
Junction City
Coburg
Cottage Grove
Creswell
Oakridge
Stayton
Sublimity
Mill City
Lyons
Scio
Jefferson
Idanha
Philomath
Monmouth
LINN
BENTON
LANE
JEFFERSON
DESCHUTES
KLAMATH
DOUGLAS

services, and flood forecasting and warning--of Federal and State agencies and Federal and State watershed management and land use programs. To attain the maximum effect, those two elements must be coordinated. This could be accomplished by: (1) making those with individual and collective management and use powers fully aware of the availability of all those programs, and (2) inspiring them to make the best use of those programs. In implementing nonstructural measures, recognition must be given to the fact that regulation of flood plain use generally is reversible; the potential of the flood plain for future uses generally is preserved, rather than eliminated, and regulations can be changed when needs warrant.

IRRIGATION

Irrigation developed relatively slowly in the basin because there had been reasonable success using naturally available water--precipitation and carryover soil moisture. However, only about one inch of precipitation occurs during July-August, the principal growing season; that amount of moisture is insufficient for best growth of many crops. Even though the growth of irrigation has been rapid in recent years, the potential still is relatively untouched; only about one-seventh of the available acreage is irrigated. Overall, the basin has an abundant supply of excellent quality water, fertile lands, and a climate conducive to production of a variety of crops. Both at and since the initial public hearings there has been a considerable and apparently growing interest in irrigation. Thus, irrigation is expected to play a vital role in the continuing growth of the basin's economy. Irrigation development can be expected to face some problems, largely in physical and economic restraints. However, it is expected that those problems would be neither extremely critical nor unresolvable.

The basic objectives of irrigation development in Willamette Basin are to:

1. Increase production of food and fiber to meet needs of an expanding population.

2. Support continued growth of the basin's economy.

3. Assure that irrigation can be developed when desired and needed.

4. Develop irrigation to complement other functions and blend harmoniously with the environment.

5. Continue research and education programs in irrigation technology.

Needs and Potentials

As related to plan formulation, irrigation needs generally are those related to water--Willamette Basin has almost 1-3/4 million acres of irrigable land, which is more than enough to satisfy the projected 2020 irrigation needs. Thus, in general, development will be limited by the availability of water. Determination of water needs was based on projections of acres to be irrigated and estimated unit water requirements.

In projecting acreage to be irrigated, consideration was given to national demands for food and fiber, and the basin's proportionate share in meeting those demands; availability of land; continuing advancement of technology; interest in community irrigation development; and probable effects of urban expansion. The resulting acreage figures are:

Table III-5
Irrigation acreages

Item	Acreages, in thousands			
	1965	1980	2000	2020
Total irrigable	1,732	1,650	1,542	1,371
Irrigated	244 1/	430	850	1,000
Remaining potential	1,488	1,220	692	371

1/ Principally by individual developments; about 40 percent from ground water.

From Tables III-1 and III-2, Appendix F.

Determination of the irrigation water requirements is based on factors of temperature, precipitation, estimated cropping practices, and depth and moisture characteristics of the soils. Consideration also was given to probable sources of supply, both surface and ground water. Map III-1 shows potential multiple-purpose storage sites with the apparent greatest potential for development to meet needs. Summarizing from Appendix F, which shows acreage, total pumping and diversion requirements, and depletions and return flows for each subbasin, the total present and projected irrigation water needs are:

Table III-6
Irrigation water requirements

Year	Requirements, 1,000 Ac.-ft.		
	Ground Water	Surface Water	Total
1965	239	330 1/	569
1980	285	874	1,159
2000	445	1,748	2,193
2020	513	1,948	2,461

1/ Amount diverted; total need was for 345,000 acre-feet.

From Tables II-13, II-14, III-3, and III-4, Appendix F.

Additional quantities of water required beyond the existing developments are shown in the following tabulation:

Year	Residual Needs, 1,000 ac.-ft.
1980	590
2000	1,624
2020	1,892

A portion of those residual needs will be met through construction of authorized storage projects listed in Part II of this appendix. Potential water supply sources available to meet the remainder include natural streamflow; existing Federal storage; new storage, for which potentials are shown on Map III-1; ground water; and farm ponds. Future irrigation development is expected to occur through both individual and group effort. The farm pond and ground water development will be primarily on an individual basis. Group development will provide the means to irrigate most of the remaining lands which are isolated from water sources. Much of the group development will be under Federal assistance programs, but a portion is expected to be on a private basis. Although irrigation is the largest potential consumptive use of water, it is projected to use less than eight percent of the basin's average annual runoff in 2020. Thus, the total average annual supply is greatly in excess of projected consumptive needs; however, extreme seasonal variation in flows now prevents full and efficient utilization of the potential.

Problems

In Willamette Basin, the principal means of developing water supplies adequate for projected needs are storage of surface water and development of ground water sources. Use of those means, however, poses a variety of

problems associated with conflict of use. Also, there will be problems of how best to use existing storage authorized for irrigation but, in some cases, potentially usable and/or now used for other beneficial purposes.

Adjudication of existing water rights and power claims is needed. The present 160-acre limitation on irrigation under certain Federal programs may pose problems in some cases.

Physically, the possibility of irrigating forest lands has not been completely evaluated. Should such development take place, it probably would not seriously tax the total basin water supply, but would require additional water storage projects.

LAND MEASURES AND WATERSHED PROTECTION

Problems and needs relating to land measures and watershed protection are a consequence of pyramiding numbers of people, coupled with changes in land use. Major factors are the increasing demands for more of the things the land offers or can produce, and for changed and better production consistent with higher standards of living. A problem which warrants more attention is the high rate of soil erosion which occurs at the time of urban, industrial, and residential construction. Statements at the initial public hearings indicated a growing public awareness of the overall problem, and a desire for improvement.

Indications are that land needs in the next few decades will involve the total land area of the basin. Thus, problems, needs, and potentials must be viewed in the light of a multiple-use plan forumlation concept--one which must embody careful consideration of the principles of wise use and efficient management of resources.

A significant increase in urban and suburban land use, from agricultural acreage, is projected in Appendix G. Table III-7 shows those changes:

Table III-7
Land use

Land Use	Present and Projected Acreage, 1,000's			
	1965	1980	2000	2020
Dryland crop	1,212	1,005	571	372
Irrigated	244	430	850	1,000
Native pasture	237	202	156	113
Woodland	5,101	5,054	4,983	4,885
Urban	332	434	568	773
Others	583	584	581	566
Totals	7,709	7,709	7,709	7,709

From Table III-1, Appendix G.

Agriculture

Needs and Potentials

Projected changes in land use, as shown in Table III-7, are the basis for estimates of conservation, group enterprise, and drainage needs.

Conservation needs, including costs to the landowner and costs of technical assistance, are detailed in Part III of Appendix G. The basin totals range from an amount of about $137 million in 1965 to a maximum of almost $317 million in 2000 then down to $308 million as of 2020. The projected shift from dry to irrigated farming is the major factor influencing future conservation needs. Some of the costs in each year will be recurring; reestablishment and maintenance is a continuing requirement. Other costs, for items such as farm ponds and drainage improvements, represent a cumulative investment in increased development.

Group enterprise needs represent the opportunity, or potential, for collective solution of some of the land-use problems. Group enterprise can be applied to the construction of small projects for drainage; irrigation; stream channel stabilization, clearing, and improvement; and levee construction. The potential, or unmet needs, for group enterprise projects in the period 1965-80 is detailed in Table III-4 of Appendix G and summarized as follows:

Table III-8
Group enterprise land-management needs

Project Type	Number of Jobs	Areas Benefited, Acres	Job Size, Feet
Irrigation	36	15,105	-
Drainage	60	50,070	691,330
Stream Channels	62	-	874,920
Levees	14	9,100	74,820

From Table III-4, Appendix G.

Drainage needs are based on changing nature and intensity of land use involving a total of 1,310,000 acres of land in classifications having wetness problems which limit agricultural use. "On-farm" drainage improvements are becoming increasingly dependent on installation of community drainage outlets to remove water from the general area. Such work involves the cooperation of two or more individuals. About three-fourths of the basin's agricultural lands need outlets of that type.

Table III-9 expresses need for drainage in terms of present and expected future accomplishments.

Table III-9
Drainage needs

Item	Present and Projected Accomplishments, Acres			
	Present	1980	2000	2020
Community drainage	307,100	543,900	774,500	852,600
On-farm drainage	466,000	585,600	869,300	1,048,000

From Tables III-6 and III-7, Appendix G.

Problems

The problems of the future are expected to be similar to, but perhaps more intense than, those of the past. Included are: (1) the continuing effects of abuse, when lands were plentiful; (2) continuing reduction in agricultural land totals, because of development patterns set in the past and the price being paid for subdivision lands; (3) the adverse effects of periodic flooding; and (4) the more intensive management requirements that go with a four-fold expansion of irrigation

development.

Forestry

The major goal of forest watershed management is to make the best use of watershed resources to meet increasing public demands. The potential exists to achieve that goal by protecting, rehabilitating, and improving the readiness of forest lands to meet demands. Measures for those purposes are related to quantity and quality of water, fish life, wildlife, and recreation.

Needs

Land treatment needs on forested watersheds vary according to use made of the land. Uses made vary with the available potential, and with ownership. As of 1965, nearly 45,000 acres of forest lands, mostly public, were in need of supplemental treatment requiring an expenditure of more than $3 million. Future treatment needs on Federal and State forest lands are summarized as follows:

Table III-10
Land treatment needs for forestry

Item	Unit	Amount 1965-80	Amount 1980-2020
Federal:			
Area disturbed	Ac.	694,500	1,227,000
Critical area	Ac.	45,600	106,000
Treatment cost	$1,000	4,188	9,912
State:			
Area disturbed	Ac.	4,900	5,000
Critical area	Ac.	215	195
Treatment cost	$1,000	5	5

From Tables III-11 and III-12, Appendix G.

Private forest lands also need conservation treatment, principally erosion control and reestablishment of timber stands. By 1975 those needs will amount to $18.5 million each, or a total of $37 million.

Problems

Future forestry problems will fall into physical, economic, social, and institutional categories. Those problems, principally of a nature not requiring specific plan formulation considerations, are discussed

in detail in Appendix G.

Appendix G also discusses possible use of forest lands for water storage development, and possible irrigation of forest land (250,000 acres by the year 2000). It outlines the relationship between forest management and future water quality, and points out the need for continuing research and basic data collection.

Urban and Other Lands

In recent years, an increasing load of sediment has been washing from construction sites, from developing areas around cities where farms are turning into housing developments and shopping centers and from highway and airport construction. Soil erosion can increase dramatically on land being converted to suburban uses--sediment discharges equivalent to 50 tons per acre annually are not uncommon.

The sediment load from those critical areas is in part a result of technological advance as a consequence of the development and use of earthmoving machines capable of scraping away acres of soil-binding cover in a few hours; but it is also a result of the indifference, or lack of information, of builders and public officials. Erosion and sedimentation need not be the unavoidable price of land development. Sediment on construction sites can be controlled, in many cases with modifications of the same practices used successfully on the agricultural and forest lands of the basin.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

The combined total of surface and ground water resources of Willamette Basin is far in excess of projected demands for municipal and industrial water supply. Thus, the potential exists to satisfy all needs, present and projected. There are, however, some local problems of distribution by areas and by seasons of the year. Map III-1 shows the locations of potential storage developments.

Needs

Statements at the initial public hearings indicated a general awareness of growing water supply needs and desire that water be stored for the future, but little knowledge of the magnitude of water supply needs. Municipal and rural-domestic needs shown in Appendix H are based on population and per capita use projections. Industrial needs are based on

present use multiplied by growth indices from Appendix C and the Columbia-North Pacific Region Type I Study. Demands for consumptive use of cooling water by potential thermal-electric generating plants are not included in estimates of M and I needs. In total, present and projected uses based on recognized trends in water use and water supply system development are:

Table III-11
M&I water supply needs by class

Item	Average Water Use, MGD			
	1965	1980	2000	2020
Municipal	170.7	361.1	562.8	920.1
Industrial	183.8	230.6	332.3	483.8
Rural-Domestic	16.2	23.1	29.7	36.9
Totals	370.7	614.8	924.8	1,440.8

From Tables II-1 and III-2, Appendix H.

Those total projected uses are distributed among the three subareas as follows:

Table III-12
M&I water supply needs, by subarea

Subarea	Average Water Use, MGD			
	1965	1980	2000	2020
Upper	55.0	114.5	169.8	244.1
Middle	107.4	166.3	240.1	333.9
Lower	208.3	334.0	514.9	862.8
Totals	370.7	614.8	924.8	1,440.8

From Tables II-1 and III-2, Appendix H.

Data as to seasonal variation for municipal and principal industrial uses, by subareas, are shown in Table III-3 of Appendix H.

Problems

Problems to be considered in plan formulation include: (1) those of source selection, (2) physical and legal availability of natural flows, (3) maintenance of presently closed watersheds for water supply, (4) increasing needs for higher degrees of treatment of raw water,

and (5) availability of assurances required by PL 85-500 for inclusion of future water supply provisions in Federal storage projects. Each of those subjects is discussed in Part III of Appendix H.

NAVIGATION

Navigation is one of the alternative means available for transportation of people and commodities. Others are land transportation by highways, pipe lines, and rail lines; and air transportation. Within the Willamette Basin study area, both land and air transportation are available and better suited to meeting the transportation needs of people. Thus, navigation needs are based on potential for movement of commodities only. Further, of the total list of commodities to be moved, only a few can be moved satisfactorily by water and more economically by water than by land or air. Part III of Appendix I, Navigation, covers types and volumes of commodities which are potentials for water movement, and the dimensions of the floating equipment required for economical transportation. It shows savings creditable to water transportation of the selected commodities. It also shows that the Willamette channel, and the flows therein, offer a potential for development and use to meet needs. Testimony at initial public hearings indicated a desire for low-cost movement of commodities in addition to rafted logs.

Needs

Commodities which could move by water at a saving in cost are identified as wood chips, rafted logs, liquified petroleum gas, greases and lubricating oils, petroleum asphalt, sand and gravel, and agricultural lime and fertilizers. Logs, chips, sand, and gravel generally would move downstream; petroleum products and agricultural supplies would move upstream. The following tabulation shows (1) potential nagivation use of Willamette River for commodities originating from or destined to the reach between Willamette Falls and Eugene, and (2) the potential annual savings under ideal conditions.

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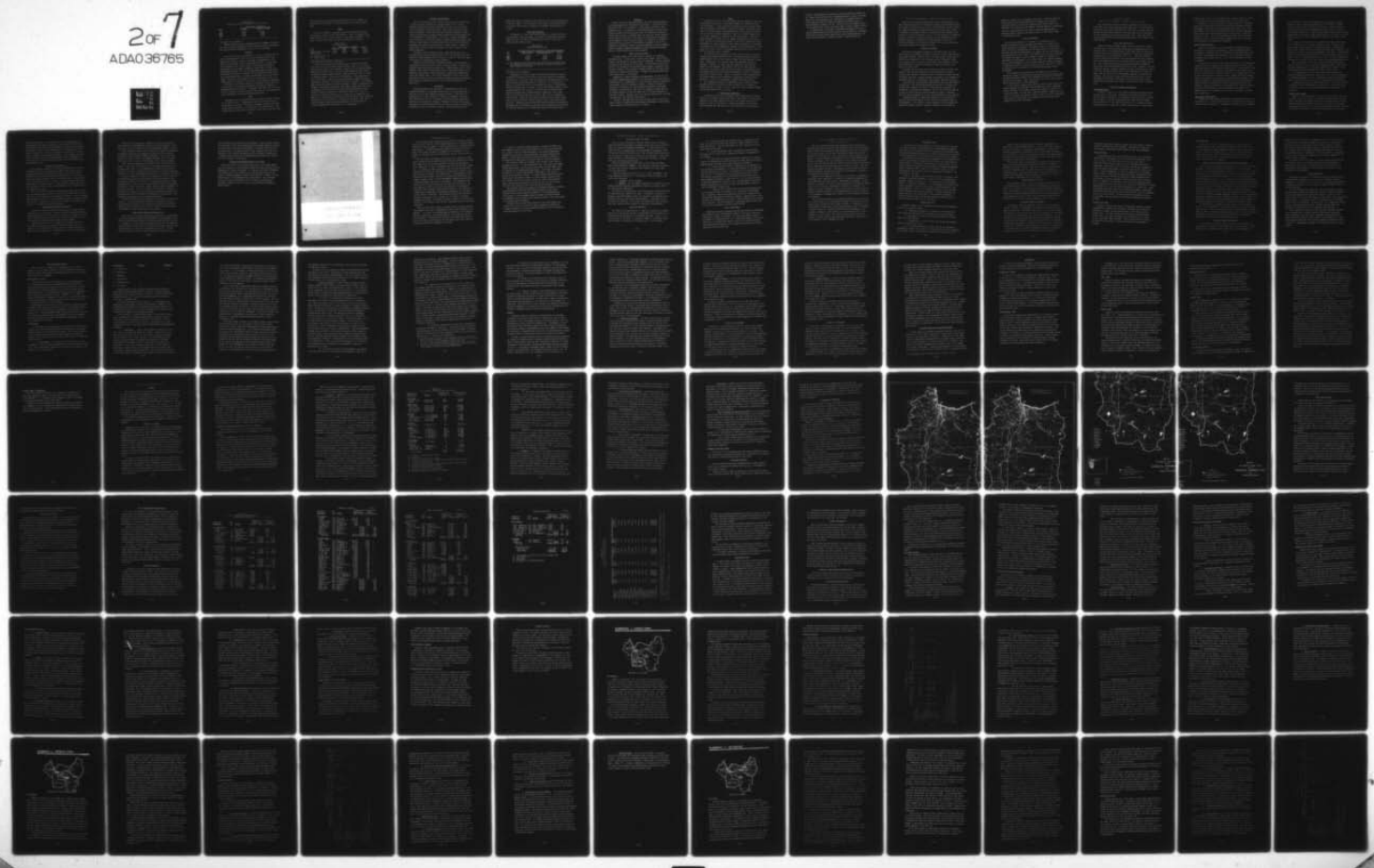


Table III-13
Potential waterborne tonnages and annual savings

Year	Projections, thousands	
	Tonnage	Transport Savings
1980	2,546	$2,600
2000	2,622	2,500
2020	2,844	2,800

From Table III-7, Appendix I.

Whether navigation can be extended upstream to Eugene, and whether the flows mentioned in Appendix I will remain available for navigation are matters covered subsequently in Part IV of this appendix.

Problems

One of the more serious navigation problems to be resolved is the need for modernizing the existing locks at Willamette Falls. The aforestated potential tonnages and savings are dependent on availability of an adequate means of by-passing the Falls. In the reach from Willamette Falls to about Albany, the principal problems in developing and maintaining a navigation channel will be those of determining available flow, and the appropriate degree of associated open-channel improvement. Upstream from the Albany-Corvallis reach, the stream slope becomes too great for successful open-channel development; slack-water development would be very expensive, as well as objectionable from fishery, flood control, and recreation standpoints.

Provision, by non-Federal entities, of adequate storage and transfer facilities for waterborne commodities at points of origin and destination would be required. In general, ample space for such facilities is available, but some conflict with plans for a Willamette Parkway or Willamette Recreational Waterway might arise.

POWER

Willamette Basin is dependent upon out-of-basin sources for much of its electric power. Transmission lines in the basin are interconnected with the rest of the Pacific Northwest regional power grid, as described in Appendix J, to bring power from those sources. With an area equal to less than five percent of that region, and with about

five percent of the installed generating capacity of the region, the basin's power requirement is almost one-fourth of the total regional load.

Needs

Part III of Appendix J contains actual use data and short-range projections of electric power requirements by class of customer; long-range projections are shown in terms of total energy and demand. Those data, for 1965, 1980, 2000, and 2020 are summarized as follows:

Table III-14
Power requirements

Item	Requirements, by Years			
	1965 1/	1980	2000	2020
Annual Energy 1,000 MWH	13,618	38,400	136,000	457,000
Demand, MW 2/	2,655	7,730	27,300	91,800

1/ Actual requirements
2/ December peak

From Tables III-1 and III-2, Appendix J.

The existing and authorized developments in the basin could meet only a part of the requirements shown for 1965. There is no existing surplus in the basin. Thus, Appendix J shows that its energy and demand requirements--by 2020 about 34 times the 1965 energy use and 90 times the basin's present peaking capacity, respectively--will have to be met by continued import of power and by development of new generating projects in the basin. Even with in-basin development, additional power transmission corridors or corridor areas will be required. Out-of-basin generation would require even greater amounts. However, recognizing that changes in technology and possibly other future changes will have to be considered, the exact location of future power generating and transmission facilities should not be specified at this time. To do so would be to limit the flexibility of the plan and its capability for adaptation to make best use of resources under changing future conditions. Recognition of such conditions is embodied in testimony at the initial public hearings, along with expressed desires for preservation of natural environment which would be lost to new projects.

Problems and Potentials

One of the problems of both the basin and the region is that there is little economic hydroelectric energy potential left. No major Willamette Basin sites remain undeveloped, and only a few such sites exist in the region outside the basin. Thus, other sources of power must be developed. Significant basin and regional potentials include those for development of pumped-storage peaking power installations, and for development of thermal plants. In terms of ultimate development, these two should be considered together; pumped-storage development could help meet peak demands and thermal plants would help to meet energy requirements and provide off-peak power for pumped storage. A number of nuclear plant siting studies are underway for future projects in the Pacific Northwest.

Potential sites for pumped storage, single-purpose hydro, and multiple-purpose projects including hydro power are identified and evaluated on a single-purpose basis in Appendix J, Part IV. Map III-1 shows the location of conventional storage potentials.

Problems involved include environmental effects, and as-yet-not-fully-known public reaction to siting, of nuclear plants. Siting must be compatible with other water and land uses. Pumped-storage plants involve possible severe overall environmental effects, including changes in the landscape, displacement of game populations, clearing for transmission lines, and similar items. Also, rapid fluctuation of water levels may have adverse effects on fish and wildlife resources and water recreation. Those potential problems will have to be evaluated and resolved as appropriate.

RECREATION

Recreation demands were developed in consideration of four basic variables--population, disposable income, mobility, and leisure time, as pertinent to water and related land-based recreation. The basis for assumptions as to those variables is contained in Appendix C, Economic Base; discussed in Part III of Appendix K, Recreation; and supported by testimony at initial public hearings. Demands are projected recognizing that people from outside the basin will use basin resources, and that some residents will use out-of-basin resources. The total projected 2020

demand for outdoor recreation is more than four times the use experienced in the early 1960's. For some parts of the basin, the projected demand in and after 2000 exceeds the capacity of available land and water resources.

Needs and Potentials

As compared to a 1963 total facility capacity of about 22 million recreation-days, projected needs, by periods, for additional facilities range from about 14 million recreation-days by 1980 to more than 34 million between 2000 and 2020.

Table III-15
Recreation facility needs

Year	Incremental Need for Facilities, 1,000 Recreation-Days		
	Water-related	Nonwater-related 1/	Total
1980	9,283	4,782	14,065
2000	13,109	6,675	19,784
2020	23,937	10,591	34,528

1/ *The nonwater-related needs shown are only one-fourth of the total; the remaining three-fourths are assumed to be met by additions to urban recreation facilities.*

From Table III-6, Appendix K.

Development at a rate to meet projected needs would leave surplus potential in some parts of the basin, but would exhaust the potential in other parts. Map III-1 shows the locations of storage potentials which might provide water-surface area for recreation. For the basin as a whole, the only deficit will be in potential for about 5 million water-related recreation days as of 2020. In the lower subarea, however, there are projected deficits of about 3.7 million and 16.2 million water-related recreation days in 2000 and 2020, respectively, and a small deficit of nonwater-related days in 2020. Table III-5 of Appendix K shows details. Except for the overall shortage of water-related potential as of 2020, deficits could be offset by use of other areas within the basin. Navigation and basin-system channel improvements subsequently discussed have the potential to meet some of the present and future needs for improved conditions for recreational boating on Willamette River.

Problems

Outdoor recreation development poses varied and complex problems, involving management of both resources and people. Those problems are discussed in Part II of Appendix K. Particularly pertinent to plan formulation are: (1) problems of conflicting demands for stored water between recreation and nonrecreation uses; (2) competition among recreation uses for water, including needs for reservoirs versus needs for free-flowing streams; and (3) the extent to which private development can be expected to meet projected demands. In addition, it should be recognized that the levels of needs shown in Appendix K and in this appendix are guidelines based on available knowledge, and that updating under the Oregon Statewide Comprehensive Outdoor Recreation Plan may result in better definition of future demands.

WATER POLLUTION CONTROL

The basic demand is for water quality suitable for recognized beneficial uses. Of those uses, domestic water supply, fish life production, and recreation are among the most demanding. All were stressed by people at the initial public hearings. The principal quality parameters to be considered are dissolved oxygen content, temperature, and bacterial content. Water quality standards adopted by the State define the goal for suitable water quality. Sediment from eroding banks and other sources also is a pollutant.

Regulation of waste discharges and augmentation of flows are two of several complementing measures for the improvement of water quality. Under Federal law, augmentation of receiving flows cannot be substituted for adequate at-source treatment of wastes. Adequate treatment is defined as no less than the waste-reduction equivalent of secondary treatment of liquid waste. That level of treatment provides about an 85 percent reduction of BOD and solids and a 95 percent reduction in bacterial content. Sediment control, by channel stabilization and watershed measures, also improves water quality.

Because of the generally high level of water quality which still exists, and the financial and environmental advantages in such quality, public demand for pollution control is strong.

Needs

Desirable levels for the three primary quality parameters, and other considerations pertinent to individual streams, are discussed in Part III of Appendix L. Those needs are consistent with water quality standards for the basin as adopted by the State of Oregon. In general, they call for dissolved oxygen concentrations equal to 90 percent of saturation in the upper subarea; generally 7 mg/l in the middle subarea, and 6 or 5 mg/l, depending on location, in the lower subarea. Basic temperature needs are stated to be for summer temperatures not in excess of 70°F. Bacterial concentrations should be less than 1,000 MPN per 100 ml. Supplemental to those standards, from a fishery standpoint, are temperature needs shown in the addendum to Appendix D, Fish and Wildlife. Those needs are for 45° to 55°F for hatching cold-water fish, and for 50° to 60°F for rearing juvenile salmonids.

With the principal exceptions of lower Tualatin River, and certain locations (principally Portland Harbor) on Willamette River, dissolved oxygen levels in the critical month of August are consistent with standards. Temperatures, for the same month, also generally conform to standards. However, the lower Long Tom, Calapooia, South Santiam, Yamhill, Molalla-Pudding, and Tualatin; many of the minor streams, particularly on the east slope of the Coast Range; and Willamette River from Eugene downstream have maximum temperatures in excess of standards during the low-flow period. Except for headwater areas, maximum bacterial counts generally exceed standards, occasionally reaching 70,000 MPN/100 ml. Table II-7 of Appendix L presents additional detail.

Flow augmentation needed to supplement at-source waste treatment and meet standards of quality is shown in Table IV-2 of Appendix L. Maximum need is to provide a flow of 7,500 cubic feet per second through the Portland Harbor reach as of 2020.

Problems and Potentials

A principal problem is the complexity and interrelation of factors related to the various needs--water supply, fish habitat, and recreation. Funding for the waste reduction portion of the program may also be a problem, in view of the need for a capital expenditure of about $105 million between 1967 and 1985 and of more than $400 million additional

by 2020. The potentials for solution include coordination programs of: (1) waste reduction and control, involving agencies, cities, and industries; (2) flow regulation, as a supplement to acceptable levels of waste reduction (Map III-1 shows the principal available sites for multiple-purpose storage); and (3) erosion control and sediment reduction on agricultural, forest, and other lands to reduce stream pollution.

If problems are to be solved, continuing cooperation will be required between Federal and State pollution control agencies, the Oregon State Water Resources Board, Federal and State fisheries agencies, and both private and public interests involved in land and water use.

ENVIRONMENTAL CONSIDERATIONS

These are considerations which, when properly incorporated in the plan formulation process, will further the concept that Willamette Basin must remain a desirable place to live. The well-being of people includes the tangible economic and financial aspects of earning a good living. It includes the intangible aspects of satisfaction from earning, and of being able to enjoy the quality of life. It also includes the continuing effects of events in the basin's history, and the intangible but all-pervading aspects of recognition of human prehistory of the area. Natural environment, for day-to-day living and for rest and recreation, has a major bearing on the quality of life.

NATURAL ENVIRONMENT

The basic environmental resources of the basin--land, air, and water--are used and valued by people for physical, social, inspirational, and economic reasons. However, many of the uses made by people tend to detract from the quality of air and water and, to a degree, of land. To the extent that air, water, or land suffer loss of quality, so will the contribution of natural environment to human well-being--to the quality of life--suffer.

The needs are to restore and to preserve--to restore quality lost because of air and water pollution, and by destruction of scenic resources and creation of eye-sores; and to preserve remaining desirable and unique resources. Balanced against those needs are the demands for development and use of resources to meet economic and physical needs.

The potentials for satisfying environmental needs are institutional and physical. The institutional potential consists of existing, and possibly new, programs for control of pollution and protection and restoration of streams and watersheds. The physical potential consists of areas of scenic beauty--streams, mountains, forests, croplands--which, by proper planning and action, can be preserved or even enhanced.

Problems entailed in using those potentials for preservation of desirable natural environment will be those of planning and those of accomplishment. The pollution control programs are being planned and enforced by Federal and State agencies, and one of the problems is

funding for construction of treatment facilities. Plans for water and related land resource development must be formulated to provide an acceptable degree of service to functional needs--flood control and irrigation, for example--and yet embody a balanced degree of preservation. With such a balanced plan, there will be the remaining problems of obtaining general acceptance and public support in the form of funds for appropriate action.

SOCIAL ENVIRONMENT

The social environment of the basin is interrelated with its natural environment and with economic development to an extent which defies quantitative evaluation. Nonetheless, there is a growing indication of need for consideration of the social aspects of esthetics in continued planning and development--for example, in power development and agricultural use of basin lands. Concurrently, there is some indication of probable willingness to pay reasonable amounts for esthetics--for maintenance and enhancement of the social aspects of a good environment. Some of that willingness is based on basic need--for example, prevention of disease and death by control of water pollution; some of it is based on appreciation of and desire for an esthetically pleasing natural environment.

Taken together, and considered in the light of where, and why, and how the people of the basin live and what they do, those basic needs and esthetic desires combine with development to reflect the nature of the social environment. Thus, they provide a basis for social environmental considerations in plan formulation.

For this study, reliance was placed on overall public response, at public hearings, to preliminary plan presentation, and at innumerable smaller meetings; and on agency response and reaction in each of the functional fields. On that basis, reasoned composite judgment was exercised. Even using that approach, however, there is a need, unsatisfied at present, for better means of evaluating social needs and project impacts on the social environment.

LEGAL AND INSTITUTIONAL CONSIDERATIONS

Plan formulation involved continued consideration of Federal and State laws, and of agency policies under those laws. Some of those laws and policies have been recognized by the Task Force as posing potential problems in implementing plans for water and land resource development. In other instances, pressing needs have been noted. Legal and institutional considerations, and potential problem areas, are discussed in the following text.

STATE LAWS AND POLICIES

Oregon's statutes relating to water use and control have evolved over many years. Those statutes reflect needs recognized and acted on during the State's continuing growth. High points were the adoption of a surface water code in 1909 and recognition, in 1955 before comparable Federal action, of 10 beneficial uses of water. Under the 1955 Act, the State Water Resources Board has issued programs and orders classifying the unappropriated waters of Willamette Basin as to highest and best use. Also, the Board has established minimum perennial streamflows below which future appropriations shall not be made. Appendix A contains additional details, including summaries of agency authorities and responsibilities, and discussions of water rights considerations, State programs, and the overall role of governmental agencies in comprehensive planning. All told, State laws and policies generally are up to date and responsive to needs. Nonetheless, there are some areas of both legislation and implementation which should be given further consideration.

Areas for Further Consideration

State Constitution

Article XI, Section 7, of the State's constitution prohibits lending the credit of the State. According to the Attorney General, that section would be violated if, in sponsoring a Federal project, the State were to agree to hold the United States free from claims of damages. However, Section 3 of the 1936 Flood Control Act, as amended, requires such assurance as a condition to Federal construction of certain flood

control works. Thus, the State cannot act to sponsor needed and economically justifiable projects authorized under various Federal laws.

Although State law now provides for several forms of local governmental entity with power to provide the required assurances, problems subsequently discussed have been experienced under those laws. Thus, an amendment to the State's constitution to permit project sponsorship under Federal law could facilitate project construction. An obvious alternative, which could be considered appropriately only at Federal legislative level, would be to further amend Federal law to eliminate the requirement for hold-and-save assurances.

Local Sponsoring Bodies

Page IV-13 of Appendix A lists 10 chapters in Oregon law which provide for or relate to the formation of local governmental entities to cooperate in Federal projects. Attention is directed therein to the one form of organization best adapted to provide assurances relative to Federal flood control projects, and to fiscal problems associated with another.

Even with local ability, under those State laws, to form sponsoring bodies, the Corps of Engineers in working with several forms of local sponsoring entities have noted that problems exist. Those problems range from local difficulty in forming an organization, under certain conditions, to physical and/or financial inability of an organization to comply with the sponsorship assurances given. Reasons for those problems range from difficulty of including, in organizational boundaries, all of the area directly or indirectly benefited to the financial difficulty, perhaps related to limited district size, experienced by some local sponsors. Potential solutions, at non-Federal level, range from enactment of State legislation to facilitate formation of larger local sponsoring bodies to amendment of the State's constitution to permit State sponsorship.

Water Rights Adjudication

Oregon Water Laws enacted on February 24, 1909 (ORS 537.010, etc.), provide that "...all water within the State from all sources of water supply belongs to the public." Nothing in the laws can be so construed

as to take away or impair the vested right of any person to surface waters, the use of which was initiated prior to February 24, 1909. A claim to a vested right, by virtue of use prior to that date and continued use thereafter can be determined and made a matter of record only through adjudication. There are many unadjudicated claims to vested rights; thus, the holders of many rights granted by the State since 1909 find a question as to the availability of water and the value of their rights.

In addition to the question of vested-rights claims based on use prior to 1909, there is a serious question of water availability for all consumptive uses upstream from Willamette Falls. Unadjudicated power claims, dating from before 1909 and totalling about 30,000 cfs, have been made to natural flows in the Willamette at the Falls. Natural flows, however, drop to less than one-tenth of that amount during the low-flow season. Thus, all upstream water rights of later date and involving consumptive use are under a cloud until those claims have been adjudicated.

Only nine streams in Willamette Basin have been adjudicated to date; two others are in the process of being adjudicated. Thus, there are many uncertainties as to the legal availability of water for both existing and potential new beneficial uses of surface water.

An assumption made for this study, that future adjudications would not appreciably change the status quo so far as flow availability is concerned, probably is valid. Nonetheless, adjudication should be given a high priority, by the State, for funding and accomplishment.

Appendixes A, Study Area; B, Hydrology; and F, Irrigation; contain discussions of water rights and the significance of rights and claims to surface water so far as plan formulation and implementation are concerned.

Thermal Plant Siting

There is a very great need for an agency or entity with authority to select, or at least approve or disapprove, thermal plant site locations. The public has shown itself to be no longer willing to accept without reservation siting decisions made by utilities acting alone. The present view appears to be that such responsibility should be vested in the state; the States of California and Washington now have such

authoritative bodies. In consideration of (1) the growing need for thermal generation, whether nuclear or fossil fueled; (2) the large quantities of water which may be required for cooling; (3) the possible environmental impact of such plants; and (4) the existence of State-adopted standards for air and water quality, it appears that a siting entity or agency would be highly desirable. Such an agency, at State level, could give appropriate consideration to state standards and objectives, and to any water-resource implications of potential sites and development plans.

FEDERAL LAWS AND POLICIES

With one general exception, as mentioned subsequently, all plan formulation was done in compliance with Federal laws and policies, as defined and interpreted in appropriate agency, departmental, Water Resources Council and other guidelines and directives. In so doing, some problem areas related to plan implementation were recognized. One of the most sifnificant was the matter of requirements for non-Federal participation in Federal projects. That and other problems which have been recognized in other areas, are discussed briefly to relate them to the study area and plan.

Public Law 91-190, the National Environmental Policy Act of 1969, and the related Executive Orders No. 11507 and No. 11514 were not available until plan formulation was substantially complete. Thus, subsequent agency studies of projects in the plan must provide the coverage required by PL 91-190. Recognition of that fact is included in subsequent text, in Part V, on potential early-action projects.

Non-Federal Participation, General

Federal laws require non-Federal participation in various phases of Federal project activities. In some cases, participation amounts to making payments for services received. In others, it amounts to paying for, or accomplishing, some part of the overall construction activity and accepting a continuing responsibility for the project.

Those laws make provision of adequate and binding assurances of non-Federal participation a condition to project construction. In practice, it has been general Federal policy to require assurances, in some form, as a condition to recommendations for project authorization.

That policy has reduced the incidence of project authorizations which could not be implemented for lack of local participation. At the same time, it poses a problem in the plan formulation stage of studies.

When construction may be several years in the future, the prospects of changing conditions and rising price levels make local entities unwilling to execute legally binding commitments. This is true even though the projects involved are needed, warranted, and fully justifiable; thus, under the best of circumstances, there can be a problem.

From a planning standpoint, the problem is one of preserving the option of future choice and decision or foreclosing that option in the planning stage; that is, of recommending an economically justifiable project on the basis of limited (or no) assurance of required local participation or of not recommending because of lack of "adequate" assurances.

From the standpoint of best use of planning effort and flexibility in meeting growing needs, and recognizing that preauthorization cost estimates are subject to escalation, the solution seems obvious: Agency recommendations for project authorization should be based on reasonable assurances of intent to cooperate, rather than on binding commitments of local participation. Even in the absence of "reasonable" assurances, justifiable and apparently needed projects and programs entailing local participation should be presented for Congressional consideration, with appropriate information as to participation prospects.

The plan formulated in this appendix is on the basis of that latter concept. Any associated Federal problems of institutional policies and constraints will have to be resolved by the Federal construction agencies and the Congress in the course of further studies leading to recommending and authorizing projects and programs.

Federal Water Projects Recreation Act

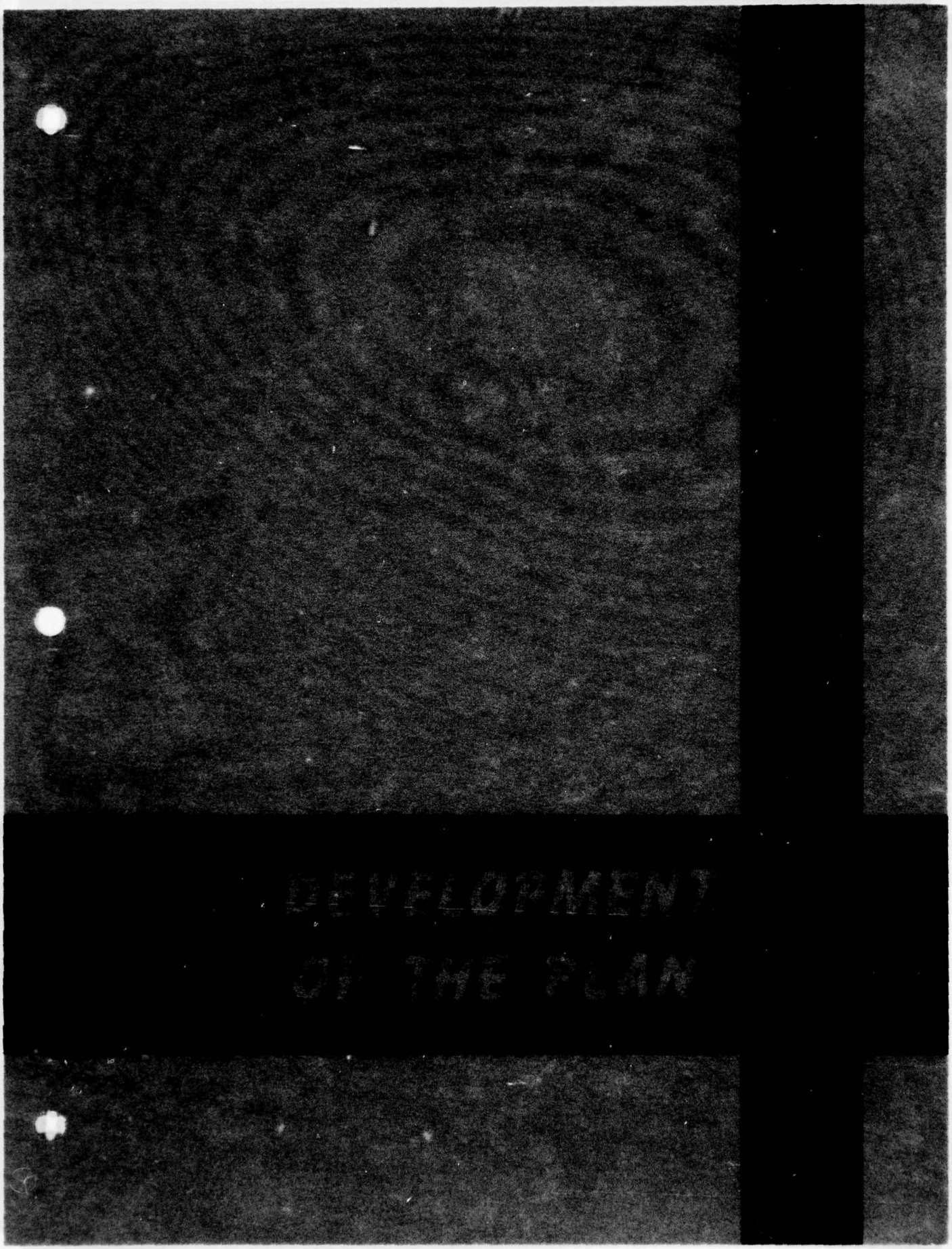
Public Law 89-72 requires non-Federal sponsorship as a prerequisite to both recreation development and developments for enhancement of certain fish and wildlife resources at certain new Federal water projects.

In general, it appears that non-Federal entities with responsibilities in Willamette Basin would be willing, to an extent consistent with fiscal ability, to comply with requirements of the Act. For some potential projects, however, limited present and foreseeable local

fiscal capability may preclude full development of the available resource. For this study, it has been assumed that those problems would be resolved on a basis which would permit development of resources consistent with projected needs. Any problems posed by that assumption will have to be resolved, by the construction agencies and the Congress, respectively, in making further studies and in considering authorization of projects for use of resources to meet needs.

National Environmental Policy Act of 1969

Public Law 91-190 sets forth national policy on all matters relating to consideration of environmental values and needs, preservation, and enhancement of overall environment. It requires that reports recommending legislation and other Federal action significantly affecting the quality of human environment include certain specific coverage, not contained herein, of environmental factors and effects. That coverage, which will require some expansion of environmental considerations included in studies to date, will have to be provided in subsequent agency reports.


DEVELOPMENT
OF THE PLAN

INTRODUCTION

Plan formulation was carried out in the light of the basic concept stated in Part I; that is, that Willamette Basin now is, and must remain, a desirable place for people. It was accomplished on a coordinated multiagency basis. It included early and continuous consideration of the views of the people who would be affected by the existence, or the absence, of potential water and related land resource projects and programs.

The coordinated, multiagency cooperative study concept was implemented further by use of State-Federal multiagency committees to collect and compile data and prepare supporting and functional appendixes. Those committees, in total, represented some 35 State and Federal agencies. In addition to agency personnel, the committees include representatives of Oregon State University, Portland State University, and the University of Oregon. Also included were representatives of public bodies such as the State Soil and Water Conservation Commission, the League of Oregon Cities, Portland Development Commission, Association of Oregon Counties, and the Port of Portland. As an example of the extent to which attention was given to local views and desires, the State employed, early in the study, the services of the Executive Secretary of the Willamette Basin Project Committee. The Committee is a quasi-public organization representing substantially all interests in each county of the basin. The Secretary compiled and furnished a listing of appropriate local contacts, in all fields of interest, throughout the basin. He worked to obtain a showing of the nature and extent of local interest and to provide continuing liaison as the study progressed.

When the study was initiated in January 1963, no overall standardized guidelines for type 2 comprehensive studies were available to all agencies. As a basis for establishing such parameters, the interests, desires, capabilities, and responsibilities of the agencies involved were determined. Information was compiled on what had been done with water and related land resources, what was known about those resources, and what was desired by residents of the basin.

A tentative coordinated budget estimate, covering all Federal and State agency activities, then was prepared. The first version provided for a study of the full scope indicated by the available background information, and private, local government, and agency interests and desires. Justification statements covering each Federal element of the estimate and supporting the overall scope of study were prepared.

The tentative budget was assembled, and reviewed in the light of departmental policy. It then was apparent that study scope and related funding requirements, in some areas, were beyond the level which could be supported by the responsible Departments. Accordingly, the budget was modified, to reflect departmental commitments to the Congress, before it was processed further. The single largest modifications were reductions in the amount of funds for land management agencies, fish life studies, and data collection activities. Other, and relatively minor, reductions also were made in scope, detail, and cost of basic data and other functional data collection and study effort.

The resulting coordinated budget was processed through the Columbia Basin Interagency Committee (CBIAC--now superseded by the Pacific Northwest River Basins Commission--PNWRBC) to the Interdepartmental Staff Council of the Interdepartmental Committee on Water Resources (a predecessor of the present Water Resources Council), and to the Bureau of the Budget and the Congress.

Overall action on that first tentative, total-study budget, particularly the actions on individual agency components, constituted a budget definition of overall comprehensiveness in terms of scope and functional emphasis for the study.

ORGANIZATION FOR PLANNING

WILLAMETTE BASIN TASK FORCE

Prior to study initiation in 1963, the Columbia Basin Interagency Committee (CBIAC) established a Willamette Basin Task Force as an entity under its Coordinated Planning Subcommittee. The Task Force was assigned the basic responsibility for coordinating the multiagency study of water and related land resources for the Willamette Basin study area. The coordinating capabilities of CBIAC and, through CBIAC, of the Interagency Committee on Water Resources, were made available to the Task Force on a when-and-as-needed basis.

CBIAC was superseded, in March 1967, by the Pacific Northwest River Basins Commission (PNWRBC). The Task Force continued to function, from that date to study completion, under PNWRBC in the same manner as it had under CBIAC.

Task Force makeup was similar to that of CBIAC and PNWRBC. Task Force membership consisted of a representative and an alternate from each of the following:

a. Chairman - State of Oregon

b. Members - (1) The Federal Departments of Agriculture; Army; Commerce; Health, Education and Welfare; Interior; and Labor, and (2) the Federal Power Commission.

The Task Force functioned as a coordinating body, meeting more than 80 times during the course of the study. In addition to serving at meetings, individual members carried out essential coordinating and expediting functions within their own Departments. Each member or his alternate was available, at all times, for consultation and discussion with other members and with agency and committee representatives.

TEAMS AND COMMITTEES

The Task Force recognized that it could not function as a complete entity on a daily basis, and that its membership did not include all of the expertise and background of the agencies involved. Thus, it took action, early in the study, to establish a number of multiagency teams and committees to function on a full-time basis. Those included:

a. A data collection and retrieval team, to compile and catalogue basic data in all functional fields for ready reference by all study participants. That team functioned, as such, principally in the early stages of the study.

b. An Outline-Schedule team, to prepare an overall outline and format for the report and to establish schedules for completion of all elements.

c. Basic data and functional appendix committees, to collect, compile, and analyze data; make projections of needs; select alternative single-purpose solutions; and prepare appendixes A through L.

d. A plan formulation team, or Technical Staff, chaired by a plan formulation coordinator, as a full-time extension of the Task Force for plan formulation activities. The Technical Staff was established late in 1967. It consisted of the same people who had made up the continuously-functioning core of the Outline-Schedule Team, and who were designated alternates to Task Force members. The staff consisted of the plan formulation coordinator, from the Department of Army, and members representing the State of Oregon, the Department of Interior, and the Department of Agriculture.

Technical Staff members acted as full-time representatives of the respective Task Force members, on a day-to-day working basis. They coordinated overall plan formulation activities, reviewed drafts of functional appendixes for technical adequacy, compiled data for this appendix, and accomplished a multitude of other formulation and coordination activities. They were supported by individual agency staffs, and by the various committees, each with staff backing.

PUBLIC INVOLVEMENT

Beginning with public hearings and carrying through the overlapping data-collection and plan-formulation stages of the study, there was a high degree of public involvement. The extent and general nature of involvement is discussed in Part III. Interested elements of the public took part, to an appropriate degree in each of the plan-formulation steps subsequently discussed, at all stages from initiation of study to completion of plan formulation.

PROCEDURES AND CRITERIA FOR PLANNING

Many of the myriad of activities involved in data collection and plan formulation were concurrent and continuing, rather than consecutive. Further, basic data required for plan formulation were not all available at one time and most such data were subjected to modification and updating as the study went on. Thus, the extent of data availability, and degree of accuracy embodied in successively more detailed studies based thereon, increased as the study progressed. Those conditions resulted in part from the fact that earlier studies had made available considerable data in some functional fields and little or none in others. Also, the adopted multiagency approach, representing a maximum practical level of comprehensiveness, entailed some problems of coordinating, scheduling, and expediting all aspects of the work.

Because of the complexities involved in carrying on a multiagency study under those conditions, a detailed, chronological presentation of plan formulation activities would be cumbersome and confusing. In the interests of brevity and clarity, plan formulation is discussed in general terms. In this section, *Procedures and Criteria for Planning*, it is presented in terms of general criteria, ground rules, concepts, and procedures considered and used; in an ensuing section on Plan Formulation, it is presented in abridged form in terms of actual formulation practice and rationale.

This section identifies the procedures developed by the Task Force as an overall guide to the formulation of plans for major projects, and those actually followed as data became available. In addition to the coordination outlined herein, the overall procedures used in formulation of plans for watershed projects within individual subbasins, as summarized in Addendum C, were carried on in coordination with the work described in this section. This section also presents the overall timing of actions and decisions which were particularly significant in the formulation of the comprehensive plan.

PROCEDURAL GUIDE

As work on the study progressed, it became apparent to the Task Force that there was a wide-spread need for standardized procedures and criteria for multiagency action in preparing and using basic data. That need encompassed matters such as overall procedures to be followed in plan formulation and requirements for basic data for that purpose.

To satisfy those needs and provide guidance for all concerned, the Task Force developed a 12-step general procedure and a detailed procedural guide to demonstrate the application of those steps. The 12-step procedure was presented to the Coordinated Planning Subcommittee, CBIAC, in December 1966. Based on the favorable reaction to that presentation, the procedural guide was prepared and published by the Task Force in June 1967.

Copies of the guide, entitled "Plan Formulation Procedures," were furnished to appendix committees; technical staff; and cooperating agencies, groups, and individuals. A summary of the steps outlined therein is reproduced as Addendum A to this appendix to illustrate the extent and nature of consideration given to plan formulation as the study progressed. Copies of the complete guide are on file with the Pacific Northwest River Basins Commission. The guide does not, for reasons staced in the introduction to this section, represent the specific procedures which finally were employed to make best use of data as increments thereof became available.

FORMULATION STEPS

The basic elements of the Willamette Basin study were identified early in the study as follows:

a. Definition and analysis of needs for water and related land resources, including specific problems, goals, and objectives.

b. Appraisal of resources and measures available to satisfy needs and lessen problems.

c. Formulation of a plan for water and related land resource control, conservation, and use.

d. A continuing program of public contacts and exchange of information, so that the plan which is formulated will be both responsive to the needs of those concerned and understood and supported by them.

Those elements were identified as leading to preparation of a report which would recommend adoption of a plan, and early accomplishment of some elements of that plan. Accomplishment of those study elements subsequently was detailed by the 12 steps shown in Addendum A to this appendix. As the study progressed, however, the timing, extent, and nature of data which became available from the coordinated effort dictated some modification of procedures.

The principal steps actually used in formulation of major project plans, and reconciliations (as appropriate) with the 12 initially defined and adopted procedural steps, are outlined in following text. It must be recognized that the steps listed are only generally in sequential order. There was considerable concurrency and overlap; for a better understanding of the time sequence of significant events, please refer to subsequent text on chronology.

Evaluate Data Availability

The evaluation of data availability was an essential first step. It provided both an initial indication of knowledge available and a basis for an estimate of time and cost to obtain necessary additional data. The compiled results, as embodied in parts of various supporting appendixes, provided background and basic data for use throughout the plan formulation activity. The evaluation had been essentially completed when the 12 steps shown in Addendum A were first defined.

Determine Problems and Needs

This step is directly comparable to Step 1 in the 12-step procedure. However, accomplishment in final detail covered the entire span of study time. The problems and needs to be considered in plan formulation, as discussed in Part III of this appendix, are classified as functional, environmental, and legal and institutional. The procedures used to obtain needs data, and an understanding of problems in each of those categories, consisted principally of: (1) holding of initial public hearings, to obtain a record of the views of those concerned; (2) preparation of an economic base study, with projections of population and other indices of growing development and need for resource use; and (3) field and office work, by appropriate

multiagency committees, agencies, groups, and individuals, to evaluate specific functional needs and problems. Information on legal and institutional considerations was developed as the study progressed.

Public Hearings

The proceedings of the initial public hearings were transcribed. Addendum B to this appendix lists the hearings and summarizes testimony. Copies of the transcript are on file with the Corps of Engineers Portland District and the Pacific Northwest River Basins Commission. That initial record of local views included statements of needs and desires with regard to potential projects and project functions. It was supplemented, as the study progressed, by continuing public contacts. Those contacts ranged from agency representative discussions with local individuals and groups through multiagency group participation in public meetings to public meetings held by the Task Force. In addition, the Executive Secretary of the Willamette Basin Project Committee, and occasionally other groups and individuals, attended substantially all of the more than 80 meetings of the Task Force. Their participation provided a medium for continuing exchange of information between the Task Force-agency complex and the public, and was of material value to the study effort. All of the Task Force meetings were open to the public, and many groups and individuals attended more than one meeting.

Economic Base Study

Appendix C contains the results of multiagency committee studies, cooperated in by Oregon State University, Portland State University, University of Oregon, and the private sector, of Willamette Basin's economic base. It covers economic characteristics, economic history, present state of economic development, and projections of the future for the years 1980, 2000, and 2020. Those projections were a part of the bases for projections of functional needs shown in Appendixes D through L.

Functional Data

Appendixes D through L present multiagency committee action to determine problems and needs in each of nine functional fields. Part I of each appendix presents background information on the function involved. Part II shows present status. Part III shows projections of future demand. Needs in each functional field are projected for the years 1980, 2000, and 2020. Those data are summarized, in general terms, in Part III of this appendix.

Evaluate Existing, Authorized, and Assured Development

This activity is comparable to combined steps 2 and 3 in the 12-step procedure. It also was carried on through much of the total study period. The development summarized in Part II of this appendix provides a measure of use of resources to meet some of the needs which now exist. It can continue in use to serve portions of most of the needs which have been projected for the future. Some parts of the existing development are Federal or Federally assisted, some are public, and some are private. Some are single-purpose in nature and have no potential for providing service in additional functional fields. Some are basically single-purpose but provide a potential for, and/or incidental services in, one or more additional fields. Others are authorized and operated for only a few of the now-recognized purposes appropriate to Federal projects, but provide incidental service in additional fields. Some elements offer a potential for physical and/or operational modification to provide a higher total degree of satisfaction of recognized functional needs.

An evaluation of the degree of service that could be realized in the future by continuation of the present operation of existing developments was made. From that evaluation, and the projected needs in 1980, 2000, and 2020, the unmet or residual needs of the future were determined. Those needs, in each of the functional fields, were considered in evaluating the economics of plans and alternatives.

Inventory Available Resources

This activity corresponds to Step 4 of the 12-step procedure. It was carried on, concurrently with other work, over a major part of the study period. Available resources which were to be considered for

possible control, use, and/or development, consist of water, land, and all of the natural resources related to water and land. Appendixes B, Hydrology; H, Water Supply; and L, Water Pollution Control, contain data on surface and ground water resources. Appendixes A, Study Area; F, Irrigation; and G, Land Measures and Watershed Protection, contain data on land resources. Appendixes D, Fish and Wildlife; I, Navigation; J, Power; and K, Recreation, contain data on resources dependent on or related to water and land.

In addition to those resources, the basin contains other resources or potentials--sites for storage projects--which are potentially developable to meet needs. A significant part of the study was the identification and evaluation of those potentials reflected in plan formulation in this appendix.

Screen Potentials

Potentials for projects and programs, including alternatives from a single-purpose standpoint, were subjected to successive levels of evaluation, or screening. This study phase is a composite, progressively accomplished over time, of basic elements of steps 4 through 11 in the 12-step procedure.

As plan formulation proceeded, the construction agencies screened storage project potentials through eight successive levels of analysis. Each of those levels further reduced the number of sites to be considered, from the more than 600 originally identified to those subsequently shown in Part V. Screening, generally in sequential order, included some or all of the following: map evaluation, field inspection, surface geology, preliminary cost estimates, detailed mapping, subsurface geology, real estate appraisal, and detailed cost estimates.

From a functional standpoint, each functional appendix committee also inventoried and screened available single-purpose potentials. County governments also assisted in screening, by expressing their views, and reasons therefor, about overall site acceptability. Those single-purpose potentials which survived committee screening are shown in Parts IV of Appendixes D through L as "Alternative Means to Satisfy Demands."

Make Formulation Studies

This activity was a composite of appropriate parts of Steps 5 through 11 in the 12-step procedure. It was initiated as soon as the first preliminary definitions of needs became available, and continued until the study was completed.

General Study Criteria

The plan formulation study was made with full consideration for the requirements and impacts of applicable Federal and State laws, and current departmental and agency policies and directives. Project formulation for individual elements of the overall and early-action plans generally was in accordance with the policies of the individual Federal construction agencies involved. Addendum C is a summary of project investigation procedures for the State of Oregon and the Federal construction agencies. Problems relating to those laws and policies are discussed in Part III of this appendix.

Upon adoption in late 1968 of the new formula for Federal discount (interest) rate, analyses using the old rate of 3-1/4 percent and pertaining to the early-action plan were updated to reflect the 4-5/8 percent rate. Subsequent agency studies and reports on specific projects will be based on interest rates as determined by the Water Resources Council, in accordance with the Water Resources Planning Act of 1965, to be appropriate at the time.

Ground Rules

To supplement and further define the application of general study criteria, the Technical Staff and Task Force adopted a set of ground rules pertinent to basin conditions and needs. Those ground rules pertain to alternatives and specific detailed concepts as considered pertinent in the light of the basic study concept, goals, and objectives stated in Part I.

a. Alternatives. - The publication "Alternatives in Water Management" lists six classes of alternatives to be considered in planning. Those alternatives, categorized for simplicity as physical, conceptual, or in part both, are:

Alternatives	Physical	Conceptual
1. Of objective		x
2. Engineering	x	
3. Management	x	x
4. Institutional		x
5. Timing and size	x	x
6. Of location	x	

Available physical and conceptual alternatives were viewed as representing multiple opportunities for action to provide a maximum-practicable overall degree of service over time. Viewed in that light, alternatives were used to develop a plan which would be responsive, over time, to changing needs.

Thus, plan formulation was not directed to the development and comparison of plans based on alternative objectives. Instead, it was concentrated on developing one comprehensive plan which would be a mix of elements consistent, over time, with the basic study concept and the overall need to enhance the well-being of people.

In that context, consideration was given to all available alternatives, including that of doing nothing (neither structural nor non-structural) so far as needs were concerned. With respect to overall functional needs, the do-nothing alternative was dismissed as totally inappropriate in view of the wide range of alternatives and opportunities available.

b. Environment. - Overall, environmental considerations were one of the most significant aspects of the plan. The basic study concept was that the basin now is, and must remain, a generally desirable place for people to live, work, and play. The well-being objective stated in Sentate Document 97 requires consideration of enhancing environment by improvements in those aspects which now detract from the quality of life. This requires consideration of such things as improvement of water quality, in Willamette River and in those tributaries where problems have been identified. Also, to prevent deterioration in some aspects of environment, it requires consideration of actions

to preserve environmental resources which now enhance the quality of life. The environmental considerations involved in plan formulation are twofold: (1) the general or overall environment of the basin which affects everyday livability, both mentally and physically; and (2) the significant natural environment which should be preserved to retain high-quality experience levels. In considering environmental aspects of the study, the wide range of desires and needs of basin residents must be recognized.

In all cases where a significant natural environmental resource was identified, the alternative of preservation (vs. development) was given serious consideration. This was done on the basis that properly planned and executed resource preservation and protection is not only good land management, but an important and vital need in the basin. The preservation alternative would serve two basic purposes. One, the obvious, would be to keep available for continued public use and enjoyment certain desirable environmental resources which would not exist if development altered the resource. The other, less obvious, purpose would be to retain the ability to make future changes as warranted by conditions not now foreseen or foreseeable. Those future changes could take the form of development of the resource to serve a beneficial purpose, or of permanent legislative classification to satisfy a preservation need.

Under this concept, studies of the range of natural values present and the potentials for all uses should be made and kept current. Decisions for change, either for development or permanent preservation, can then be made as appropriate. In the interim, development which would impair the environmental values of those resources and reduce or eliminate future options should not be allowed. Further, it was recognized that development, properly planned and located and to an appropriate degree, does not necessarily despoil overall environment. On the contrary, development to serve functional needs clearly can enhance the total environment in which basin residents spend their day-to-day lives, and thus the overall quality of life for basin residents. This emphasizes the fact that overall developmental and

environmental objectives are not necessarily and in total conflicting and mutually exclusive.

Obviously, it was not possible to adopt the preservation-protection alternative in all cases. Satisfaction of needs requires that some resources be developed to varying degrees. Also, the concept of flexible management, preservation, and protection is not totally consistent with the views of all concerned public groups.

c. Specific concepts. - A basic concept was that multiple-purpose storage projects would be a primary means of Federal action to satisfy needs for control and conservation of water. At the same time, it was recognized that the private sector had ability to, and probably would, make both storage and nonstorage developments in some functional fields. Major considerations supporting that concept are:

(1) There are two principal alternatives to storage development as a means of providing additional water for downstream use. Those alternatives consist of development and use of the ground water resource, and watershed management programs to increase low-water flows. In general, the ground water alternative was considered adaptable only to serving certain relatively limited irrigation and domestic-municipal water supply needs. The respective functional appendixes contain projections of probable ground water use; it was considered that the degree of such use would be about as indicated therein, subject to final outcome of plan formulation studies. In some cases, the ground water supply would be the limiting factor; in others the cost, as compared to cost of developing a surface-water (storage) source, would preclude extensive reliance on ground water. Watershed management programs were considered to be desirable multiple-purpose elements of the overall plan. Those programs would be capable of improving water quality, enhancing reservoir-filling potential, and reducing siltation, but incapable of meeting any significant part of total downstream needs for increased flow. Thus, from a practical standpoint, such programs were considered to be supplemental or complementary, rather than alternative, to storage.

(2) Recreation, wildlife, and environmental alternatives to storage would consist of preservation and management, singly or in

combination as appropriate. Some management measures would be an appropriate adjunct to storage development. Decisions regarding those alternatives were made in part on a judgment basis, in consideration of local views and available qualitative and quantitative impact data. This consideration took into account the nature, location with respect to population, and relative desirability of environment which could be preserved. Also, consideration was given to the relative degree of overall needs satisfaction inherent in each alternative, the degree of economic justification for storage, and the probable extent of private-sector development capability.

(3) Regulation of flood plain use, to limit increase in flood-damage potential, would be an alternative to any potential single-purpose development for flood control. However, it was considered as a supplement, rather than an alternative, to the flood control function of multiple-purpose storage. Reasons for that decision were several. First, substantially all flood control effects of multiple-purpose storage would be achieved by joint use of space required for water-conservation purposes. Thus, the total flood control cost associated with multiple-purpose storage would be very small. 1/ Second, unless advantage were taken of the economies of joint-use storage and the flood control benefits 2/ obtainable thereby, many projects, which would be the only practical means of satisfying multiple needs for water conservation, would lack economic justification. Finally, failure to operate multiple-purpose projects for flood control would amount to less-than-full use of site potential, generally without an increase in other benefits commensurate with the loss in flood-control benefits.

(4) Potential single-purpose projects were considered to be generally suitable for many areas. Included were those areas where multiple-purpose storage was omitted from the plan because of adverse impacts on environment and other unresolved problems such as high cost or apparent lack of required local sponsorship.

1/ *For four typical existing multiple-purpose projects in Willamette Basin the total increment of cost (separable cost) for flood control is in the order of five percent of total project cost.*

2/ *For four typical existing multiple-purpose projects in Willamette River Basin flood control benefits average about two-thirds of the total evaluated benefits for authorized purposes.*

(5) Regulation of flood plain use was considered as a local-responsibility alternative to single-purpose projects for flood-damage reduction. Also, as previously discussed, regulation would be an essential supplement to existing and potential new storage and nonstorage projects in order for the desirable degree of future flood damage reduction to be attained.

(6) Needs to be considered in plan formulation would be those remaining after allowance for the effects of existing, authorized, and assured development, probable additional accomplishments in the private sector, and probable additional accomplishment under ongoing programs.

(7) Programs, in general, were considered to be a part of the overall plan, and were listed as early-action elements to the extent warranted by magnitude and severity of need, consistent with current policy on program implementation. In some cases, a need for accelerated action under ongoing programs, or for initiation of new programs, was identified. The rationale for program action, as presented in appropriate functional appendixes, was reviewed by the Task Force and generally was accepted as adequate evidence of need and justification.

Studies

Formulation studies consisted of matching needs with available potentials for resource control and use. Matching was done in successive phases, over a considerable portion of the study period. The first matching was in terms of physical capabilities. Subsequently, as more detailed data were developed, matching was done through both physical and economic analyses, supplemented by policy and judgment considerations. As noted above, consideration was given first to multiple-purpose storage potentials then to single-purpose projects and alternatives thereto.

Economic analyses presented herein for individual projects generally are limited to determinations of apparent overall economic feasibility. Major storage projects generally were considered as elements of a system incremental to the existing, authorized, and assured projects discussed in Part II. Continuing or subsequent agency studies for reports making specific recommendations to the Congress will have to cover: (1) net benefit maximization, (2) cost allocation, (3) determination of

economic feasibility for individual functions of multiple-purpose projects, and (4) cost-sharing analyses when required. With the possible exception of changed timing (long-range, instead of early-action, or vice-versa) such studies are not expected to indicate any need for change in the overall basin plan. Because benefits are of a localized nature, potential projects under the Watershed Protection and Flood Prevention Act of 1954, PL 83-566, as amended, and certain other tributary projects were analyzed individually for each watershed. The probable effects of the total system on downstream flows, however, are reflected in the system hydraulic analyses discussed in the ensuing section.

Formulation of the comprehensive basin plan included consideration of problems and needs at watershed, subbasin, and basin-wide levels. Those considerations, carried on concurrently and in coordination, provided a practical means of matching needs with potentials and a rationale for selection of plan elements. Watershed investigation reports were prepared in consideration of needs in 126 watersheds on the basis of established policies and guidelines as shown in Addendum C.

Formulation of major project elements was accomplished by use of a coordinated two-part approach, considering basin and subbasin levels of needs. The two parts of the approach were executed by the same basic multiagency group, using the same basic data as to needs and potentials. Separate discussion herein is only for the purpose of clarity in illustrating the full scope of investigations.

a. Basin-system aspects. - The basin system aspects of formulation consisted of evaluating the effect of upstream storage projects in meeting needs downstream along Willamette River as well as in the watersheds and subbasins. It also included analysis of nonstorage projects directly related to storage system operation. Consistent with specific storage concepts already stated, the basin-wide analysis matched basin needs against the services which could be provided by systems of storage projects, in successively more detailed approximations as data became available. The first approximation was on a single-purpose basis, using flood control storage and stage-reduction needs as a measure of probable desired storage system capability. Subsequent approximations included inputs of additional functional needs. Each

successive system approximation included existing and authorized storage projects. Watershed storage projects were included, either singly or as subsystems, in evaluating needs and project effects. When the storage system had been selected, remaining needs were considered for possible satisfaction by supplemental and complementary single-purpose projects and basin-wide programs.

b. Subbasin aspects. - In the concurrent subbasin aspects of the two-part approach, needs and potentials were matched and a plan-formulation rationale was developed for potential projects in each of the 11 subbasins. The subbasin analyses used subbasin potentials; needs identified for and/or apportioned to the subbasins; and, to the extent practicable as the study progressed, consideration of downstream out-of-subbasin needs. Together with the basin-system aspects of formulation, the subbasin analyses provided a good definition of basic elements of the final basin plan.

In order to maintain coordinated action and make best use of available data, comparisons of results were made as both aspects of the two-part approach were carried on. Adjustments, based on those comparisons and on concurrent watershed analyses, were incorporated in the successive-approximation analyses as judgment indicated such action to be warranted. A final consolidation and refinement of results, near the end of the study, permitted definition of project elements of the basin plan, as summarized in Part V.

Timing for Development

In addition to determining what elements--projects and programs--should be in the comprehensive basin plan, the study selected those elements on which action should be taken within 10 to 15 years. That activity included elements of steps 8 through 12 in the 12-step procedure. The physical (hydraulic) analyses discussed in preceding text served to show: (1) the most effective combination of potential storage projects for addition to existing and assured development to meet projected needs for additional development, as already discussed; and (2) the extent to which each project would contribute to meeting those needs.

A ranking in priority for implementation could be made on the basis of physical analyses alone. However, some projects which would be given high priority on that basis would not be needed in the near future to

successive system approximation included existing and authorized storage projects. Watershed storage projects were included, either singly or as subsystems, in evaluating needs and project effects. When the storage system had been selected, remaining needs were considered for possible satisfaction by supplemental and complementary single-purpose projects and basin-wide programs.

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A ranking in priority for implementation could be made on the basis of physical analyses alone. However, some projects which would be given high priority on that basis would not be needed in the near future to

an extent which now would permit a showing of economic justification. For that reason economic analyses were made for various combinations of projects to provide additional support for timing decisions.

Early-action storage projects were selected from among overall plan elements on the basis of those factors and with appropriate consideration of the expressed views of people concerned and pertinent qualitative impact data. However, for reasons shown in the ensuing section, some potential projects were listed as alternatives; such projects, while not compatible with presently defined objectives, have physical and as-yet-undefined economic potential for future use under changed conditions. Other potential projects not included in the plan are listed as opportunities for future development.

Since single-purpose projects generally would not be considered as alternatives to multiple-purpose storage projects 1/, timing decisions for such projects were based on a combination of: (1) degree of satisfaction provided for present and projected needs, (2) economic status, and (3) the views of the people concerned. In some cases, planning judgment and careful analyses indicated that early action would be appropriate, but legally required local support was not demonstrated. In those cases, the project generally was placed in the early-action category; it was recognized that further study would be made before recommendation to the Congress; that the Congress would use its judgment as to authorization; and that, even if the project were authorized, no construction could be done until local sponsorship was provided.

Remaining Needs and Unresolved Problems

In some cases, the available potentials apparently could not be developed to a level which would meet all needs, either in the early-action or long-range phase of the plan. A definition of those unmet needs, and appropriate recommendations for further research and study, is an essential adjunct to the plan formulated for the basin. Also, some of the problems recognized and outlined in Part III lie beyond the purview of this study. Considerations pertinent to those problems were outlined to permit study and possible action at appropriate levels.

1/ See preceding text on ground rules, specific concepts.

Chronology

To clarify the procedure followed in plan formulation studies, the timing of significant associated events and chronological information on plan formulation steps are discussed in following paragraphs.

Fall-Winter, 1966-67

In early fall of 1966, the economic base study committee presented to the Task Force a first draft of Appendix C, Economic Base. That draft contained the first information as to projected population growth, economic development, etc., to be generally available to the Task Force and the functional appendix committees. On that basis, those other committees were able to begin to analyze conditions in terms of projected future needs.

In early winter of 1966, a listing of potential storage sites was prepared, to show which appeared to have the most possibility of being included in the plan for development. That listing was distributed to committees and agencies for consideration in connection with the draft of Economic Base Appendix. It did not represent a specific plan formulation step, but provided a basis and an incentive for appropriate plan formulation input.

Spring-Summer, 1967

Work during the period was highlighted by a first public presentation of projected population, economic development, and resource-development needs. Those projections were for the future years 1980, 2000, and 2020. Resource-development projects were based on a preliminary analysis, in the light of economic base data, of total needs in the nine functional fields covered by Appendixes D through L. Brochures summarizing economic and needs projections were prepared and presented to the public at a widely-publicized and well-attended meeting in Salem, in the Middle Subarea, during this period. Many additional copies subsequently were distributed at group and agency meetings throughout the basin. The overall public reaction was one of general acceptance of and concurrence with those projections.

Throughout all of the period, work continued unabated on screening of site potentials; collection of basic functional data; and extending, refining, and improving the accuracy of committee-developed functional appendix data. This included functional needs and alternative single-purpose means to meet demands.

Fall, 1967

During the period, the Task Force selected and assigned a plan formulation coordinator and a technical staff for plan formulation. The people involved were the same State and Federal agency representatives who had earlier worked as a team to develop outlines and schedules for the basic data and functional appendixes.

During the period, the coordinator, with agency and committee assistance, concentrated on subbasin analyses to detect, and define the extent of, any data shortage and to identify potential plan elements.

The principal effort of the appendix committees and technical staff was in completing drafts of functional appendixes for initial review at Task Force level.

Winter, 1968

During the winter two particularly significant steps were taken. Those were: (1) a refined definition of a base system of storage projects which existed or were authorized and/or assured was distributed to all agencies; (2) a refined, but still preliminary, definition of potential early-action and long-range additions to that system also was distributed. Those steps were intended to provide information to resource agencies working on functional appendixes and to obtain, for the formulation coordinator and technical staff, an expression of resource-agency views thereon. That action was a part of the continuing agency evaluation and communication effort shown in the chart in Addendum A.

Evaluations also were being made of the future effects of the overall reference base of existing, authorized, and assured development. Because of the lack of complete functional needs and means data, considerable use of multiagency composite judgment was required for selection of potential storage projects. Thus, technical staff and committees placed additional emphasis on completion of functional appendixes and

on obtaining expressions of agency and committee reaction to the potential storage projects.

Spring-Summer, 1968

During the period, system analyses were being made to evaluate the potential early-action storage projects first listed as above, plus various modifications, operational and physical, of the base storage system. The work was done specifically to assist in arriving at a preliminary plan which could be presented to the public for comment.

At the same time that system analyses were being made, the functional appendix committees continued to strive for completion of accurate and adequate data presentations.

August, 1968

August 1968 marked a significant step. At that time, at a widely-publicized and well-attended public meeting in the State Capitol in Salem, the Task Force made a public presentation of a preliminary plan. The storage elements of that plan had been subjected to extensive hydrualic analysis and some preliminary economic analysis.

Public reaction to the preliminary plan generally was very favorable. The only request for significant change came from the middle subarea. Residents of that area were concerned that: (1) a potential modification to the authorized navigation project for Willamette River did not extend far enough upstream, and (2) a potential reservoir project on Marys River was not included in the early-action plan. Other comments generally were favorable, or in the nature of inquiry rather than criticism. All told, the overall public reaction constituted a summary of the results of a preliminary, but widespread, screening from the standpoint of social and conservation considerations.

At that same meeting, the Task Force announced the impending adoption of the new Federal discount rate formula, and drew some tentative conclusions as to its effect on the plan as then presented.

Fall-Winter, 1968-69

During the fall-winter period, the technical staff, plan formulation coordinator, and the construction agencies responded, as appropriate,

to reactions and comments resulting from the preliminary plan presentation. Also, in late fall, work began on preparing working summaries of subbasin considerations, which continued to be inputs to plan formulation, for the use of the report writer.

The work of the technical staff, formulation coordinator, and agencies was divided into two phases. One consisted of making refinements to individual project plans and the evolving comprehensive basin plan. That phase included all of the elements of response to public reaction stemming from the preliminary plan presentation. The other phase consisted of increased pressure for completion of functional appendixes. The Task Force members shared in the actions aimed at obtaining firm data and adequate appendix coverage. They provided coordination, expediting work where possible, and reviewed drafts as furnished through the technical staff. Also, at closely-spaced meetings, they kept track of overall progress and problems.

It was early during the fall-winter period that problems in completing functional appendixes became critically apparent. Those problems included updating annual costs to reflect the new discount rate and last-minute changes in and additions to basic functional needs and benefits data, as well as problems of review, editing, and reproduction.

Because of those changes, the plan formulation coordinator, technical staff, and construction agencies were not able to complete plan formulation activities to the extent originally planned. The basic omissions were those steps which would have been necessary were the multiagency report, of itself, to be used as an authorization vehicle. Most important, from that standpoint, was inability to obtain sufficient benefit data, when needed and for all functions, to permit project sizing and cost allocation studies. In the absence of those studies (particularly cost allocation studies for reservoirs), the probability of overall justification could be shown. However, it was not possible to ascertain that each individual function would be justified and that net benefits would be maximized; neither could it be determined whether local participation involving cost-sharing or reimbursement would be available.

Spring, 1969, to Completion

The entire period was used for: (1) completion and publication of functional appendixes, some of which were not yet in reproduction in early September; (2) completion of plan formulation; and (3) drafting and editing this appendix and the main report.

During the period, the Recreation Committee prepared a recommendation, Addendum E to this appendix, for preservation of natural environment on selected streams. That recommendation resulted in subsequently described refinements to the plan.

PLAN FORMULATION

GENERAL

This section of Part IV sets forth and illustrates the formulation of a water and related land resources plan for Willamette River Basin. It shows how needs, as now existing and as projected for the future and detailed in functional appendixes D through L, can be met. The means considered, in total, are consolidated and refined to become the basic elements of an overall comprehensive plan. They include: (1) continued use of existing developments, (2) completion of authorized and assured development, (3) anticipated additional private and non-Federal public development, (4) ongoing and new programs, and (5) development of new projects and appropriate modification of existing and assured projects.

The general procedures used, and the chronology of significant events, are discussed in the preceding section on Procedures and Criteria for Planning.

Problems and Needs

Willamette River is the outlet for streams in nine of the subbasins; flow regulation at tributary sites in the upstream subbasin affects flows throughout all of Willamette River downstream from the tributary. Thus, storage project operation for all purposes involving flow regulation generally must be on a coordinated basin-wide system basis. The only exceptions would be for those projects which, because of location or small size, would have no significant effect outside the tributary watershed. Included in that category are some of the potential small reservoirs included in projects under Public Law 83-566. Even when operated in the interest of serving subbasin needs, however, some of those excepted projects would have a measurable effect on downstream floods and low-water flows.

To obtain a proper evaluation of overall service to needs, and of justification for potential new storage projects, the effects of all those projects were analyzed and incorporated, as appropriate, in plan formulation. Formulation of plans for those excepted projects, however, generally was on an individual-project basis using tributary basin needs as a controlling consideration but considering possible downstream benefits where appropriate.

Because of the system operation requirement for multiple-purpose storage projects, hydraulic system analyses on the electronic computer were on the basis of total needs and total systems of projects. Economic analyses for potential new projects in those systems, however, were based on the extent to which those new projects would meet needs not satisfied by existing and assured development.

Total functional needs of the basin, as of 1980, 2000, and 2020, are shown in Appendixes D through L in terms appropriate to the individual functions. Land measures, watershed protection, and wildlife needs generally are expressed in (or can be related to) areas of land and/or programs on land areas. Needs in the other functional categories can be expressed in terms of needed flow, and/or as surface-area and volume parameters of storage. Flow and storage needs for water pollution control, recreation, water supply, and fish life functions are accompanied by requirements as to quality of water stored and released.

Existing, Authorized, and Assured Development Effects

The development to be considered includes all of the projects, programs, and private-sector elements discussed in Part II of this appendix.

From the standpoint of overall service in functional fields, and consistent with aforestated basic study concepts, the principal development to be considered consists of major multiple-purpose storage projects. However, some of the single-purpose developments also provide a significant degree of service, and will continue to do so. All of those projects were defined by the Task Force, early in the study, as a base system. The base system, as so defined, consists of projects (1) existing; (2) authorized, including those then under construction; and (3) assured, on the basis that studies then being prosecuted under specific separate authorization indicated probable economic justification. (Subsequent changes in the interest rate to be used in plan formulation have resulted in one element of that base system being given additional study. That element is shown on Table IV-1, but also is listed in Part V for early action.)

Table IV-1 lists the elements of a base system of Federal storage projects, as established early during this study. Additional data on those projects are shown in Table V-2.

a. Projects. - Operation of base-system projects under existing authorizations would meet a portion of the projected needs in the eight functional fields. The existing Federal storage projects are operated, as a system, for flood control, navigation, irrigation, and power generation. Under that operation schedule, the projects provide significant incidental benefits to water quality improvement, reservoir and downstream recreation, and fish life.

Evaluation of storage project effects in the four presently authorized functional fields had been made, both prior to project authorization and as a part of subsequent detailed planning studies. Those studies had been made manually, using flood- and flow-routing procedures developed by the Corps of Engineers. The overall procedure had been found workable, and had been verified as being adequately accurate for both study and operational purposes. However, it was laborious, and too demanding of time and manpower to permit its use for this study. Consequently, new procedures had to be developed.

Flow parameters of needs in all functional fields for which parameters were identified can be stated for control points representative of reaches in which needs exist. Storage effects on flows at project sites can be set forth in operating schedules, and the effect of channel storage on in-stream flows can be defined. Thus, with existing flood-routing knowledge, it was possible to develop mathematical models of the Willamette River stream system and express them in programs suitable for use in the electronic computer. Those programs are on file with the Corps of Engineers and are available for study and use by others.

One model and program covers the flood-season aspects of storage. It provides for inputs of instantaneous flows, at appropriate locations and time intervals to reflect the flashy character of flood runoff in the headwater areas. Input data are available to cover a period of 41 years of past record, 1926 through 1966, inclusive. That period includes floods up to the magnitude of that of December 1964, which had a recurrence frequency of once in about 100 years over much of the basin. Data output includes reservoir content, outflow, and resulting regulated

Table IV-1

Base system of Federal storage reservoirs

Subbasin and Reservoir	Stream	Drainage Area, Sq. mi.	Usable Capacity, Ac.-ft.
Coast Fork:			
Cottage Grove	Coast Fork	104	30,000
Dorena	Row River	265	70,500
Middle Fork:			
Hills Creek	Middle Fork	389 1/	249,000
Lookout Point	Middle Fork	991 1/	349,000
Dexter Rereg.	Middle Fork	996	4,800
Fall Creek	Fall Creek	184	115,000
McKenzie:			
Cougar	S. Fk. McKenzie	208 3/	165,000
Strube Rereg. 2/	S. Fk. McKenzie	216	3,000
Blue River	Blue River	88	85,000
Gate Creek 2/	Gate Creek	50	50,000
Long Tom:			
Fern Ridge	Long Tom R.	275 4/	109,000 5/
Santiam:			
Holley 2/	Calapooia R.	105	90,000
Cascadia 2/	S. Santiam R.	179 6/	145,000
Green Peter	M. Santiam R.	277 6/	333,000
Foster	S. Santiam R.	494	33,600
Detroit	N. Santiam R.	438 7/	340,000
Big Cliff Rereg.	N. Santiam R.	452	2,400
Coast Range:			
Gorge 8/	Mill Creek	31	50,000
Tualatin:			
Scoggins 2/	Scoggins Cr.	39	53,000
McKay Creek 9/	McKay Cr.)	43	23,100
Rock Creek 9/	Rock Cr.)		
Basin Totals		3,342	2,300,400

1/ *Included in area shown for Dexter.*
2/ *Authorized.*
3/ *Included in area shown for Strube.*
4/ *Includes 23 square miles in Amazon Creek drainage, from which some flood flows are diverted.*
5/ *Includes 15,000 acre-feet of single-purpose flood control storage.*
6/ *Included in area shown for Foster.*
7/ *Included in area shown for Big Cliff.*
8/ *Subsequently shifted to early-action.*
9/ *Watershed projects considered to be assured.*

flows at all downstream control points. The program is adaptable to use of alternative project locations, sizes, and operating schedules at individual reservoirs.

The other model and program covers the conservation aspects of storage. It uses inputs, in the form of mean monthly flows, for the same locations and for the period 1926-1965. It also provides for inputs to represent net consumptive uses, or depletions, at appropriate points in the basin. Printouts provide information in the same units, and for the same locations, as for the flood control program. Modified operating schedules, as well as changed points and amounts of storage use, can be analyzed.

Both programs were verified, then used to evaluate future service from existing, authorized, and assured storage projects. Because of machine limitations it was necessary, in some cases, to analyze tributary subsystems and then incorporate those subsystem results as inputs in an overall storage system analysis. Printouts showing the details of the evaluation are on file with the Portland, Oregon, District of the Corps of Engineers.

Inspection of the printouts showed that existing and authorized storage projects, operated as now scheduled under existing authorization, would fall considerably short of meeting all future needs. Because of the magnitude of the unmet needs, it was obvious that operational change alone would not provide an adequate degree of service in any functional field; also, any significant change to benefit one function would act to the detriment of others. Thus, consideration was given to the potentials for additional development.

b. Programs. - In general, the programs discussed earlier in this section would have little or no significant effect on physical need for flow regulation or storage. Watershed management practices would tend to reduce flood flows and increase low-water flows, and to improve the quality of water available at all seasons. However, Appendix G shows that there remains a need to identify more accurately the relationships between forest land use and effects on timing and yields of water. On that basis, it is considered that the effect of such practices would be of consequence principally in and near the individual watersheds, but not in reaches of Willamette River and major

tributaries studied in system analyses. Similarly, the effects of other programs are considered to be not of sufficient overall magnitude to be significant in system analyses.

c. Private-sector development. - Both private-sector and public non-Federal developments are anticipated. This report and recommendations herein will have no power to cause, or to prevent, any such development. Decisions in all such matters will be at the option of the private individuals and groups, and the public bodies, involved. It appears, however, that a reasonable estimate of both nature and extent of possible significant development in this category can be made.

Power generation is one area in which development is anticipated. It is known that there is interest in and planning for development of multimegawatt nuclear-fueled thermal power-generating installations in the basin. Development might come in or near the early-action period. Such development would be useful in meeting projected loads, and would not result in elimination from the plan of any potential conventional power installations in the basin. It could provide a part of the energy base to support peaking power installations, but would, however, present needs which might be met by development of water resource storage projects.

Large amounts of dependable off-peak power from future large thermal plants would be available in the region for pumping at potential pumped-storage peaking power installations. Sites for several such projects are identified in Appendix J, with the notation that additional planning will be required to determine when and how pumped storage would best fit into the Region's load pattern.

For thermal generating plants, the needs would be for consumptive use, in cooling operations, of a significant but not definitely established volume of water. Depending on sites finally selected and on type of installation--once-through cooling cannot be used within the limits set by State water quality standards--such water might be from various sources. Included are natural flows; releases from existing and/or new Federal storage, from new private or public non-Federal storage; or some combination of natural flows and storage releases.

Recreation is another area in which the private sector, individually or by group action, is expected to develop facilities to meet needs. No estimate of probable developments has been made. It appears, however, that the greatest potential for financially successful operations lies in areas near major population centers and west of Willamette River where public developments now are at a minimum. On the basis of such location, and the overall magnitude of needs, it appears that a reasonable degree of coordination would eliminate any problems of possible duplication and local over-supply. Part V, Recreation programs, discusses the need for agency-public coordination, through committee action, to avoid such problems.

Water treatment and waste purification is a third significant area in which the private sector has an opportunity, and is expected, to develop facilities to meet needs. As with recreation, above, no estimate of location and/or probable extent of developments has been made. However, Appendix C contains projections of population and economic growth, by subareas, which indicate the general locations of needs and of opportunities for private-sector action.

Private-sector developments in other functional fields are expected to be complementary to potential plan elements and/or accomplished in connection with overall programs discussed in Part V.

Thus, overall, private-sector development is not anticipated to have significant effect on the needs for or justification of any potential agency projects, at least in the initial 10 to 15 years following study completion.

Summary of Residual Needs

On the basis of the foregoing, only the storage elements of existing, authorized, and assured development are anticipated to have significant effect in meeting future physical (flow) needs.

Available Resources

The basic data and functional appendixes detail those resources which can be considered for possible control, use, or development to meet projected needs.

Storage sites which might be developed to control and facilitate use of the water resource for multiple benefits are a significant resource.

In spite of the fact that there is a substantial total of existing, authorized, and assured storage development, many sites remain undeveloped. Map and ground reconnaissance, participated in cooperatively by the three Federal construction agencies, resulted in a listing of more than 600 potential project sites. Map IV-1 shows the location of those sites, as listed in Addendum G.

Screening of Potentials

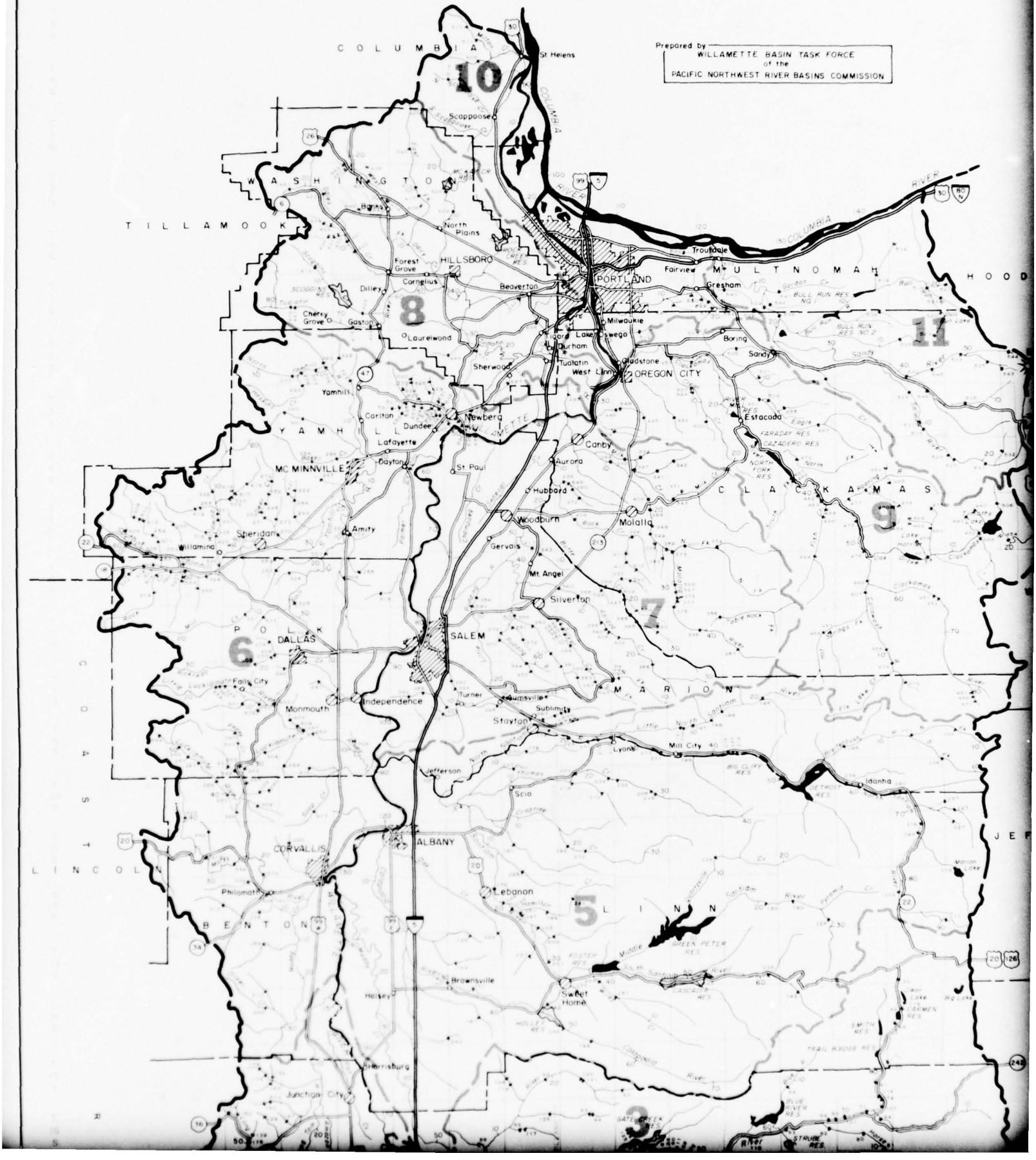
As can be seen on Map IV-1, many of those potential storage sites represent mutually exclusive alternatives. Many are in areas from which runoff already is subjected to a high degree of control. Many others involve substantial problems. These include poor foundations, high-cost lands and development in the reservoir area, extensive and expensive relocations, significant anadromous fish runs, and unique environmental aspects, singly or in some combination.

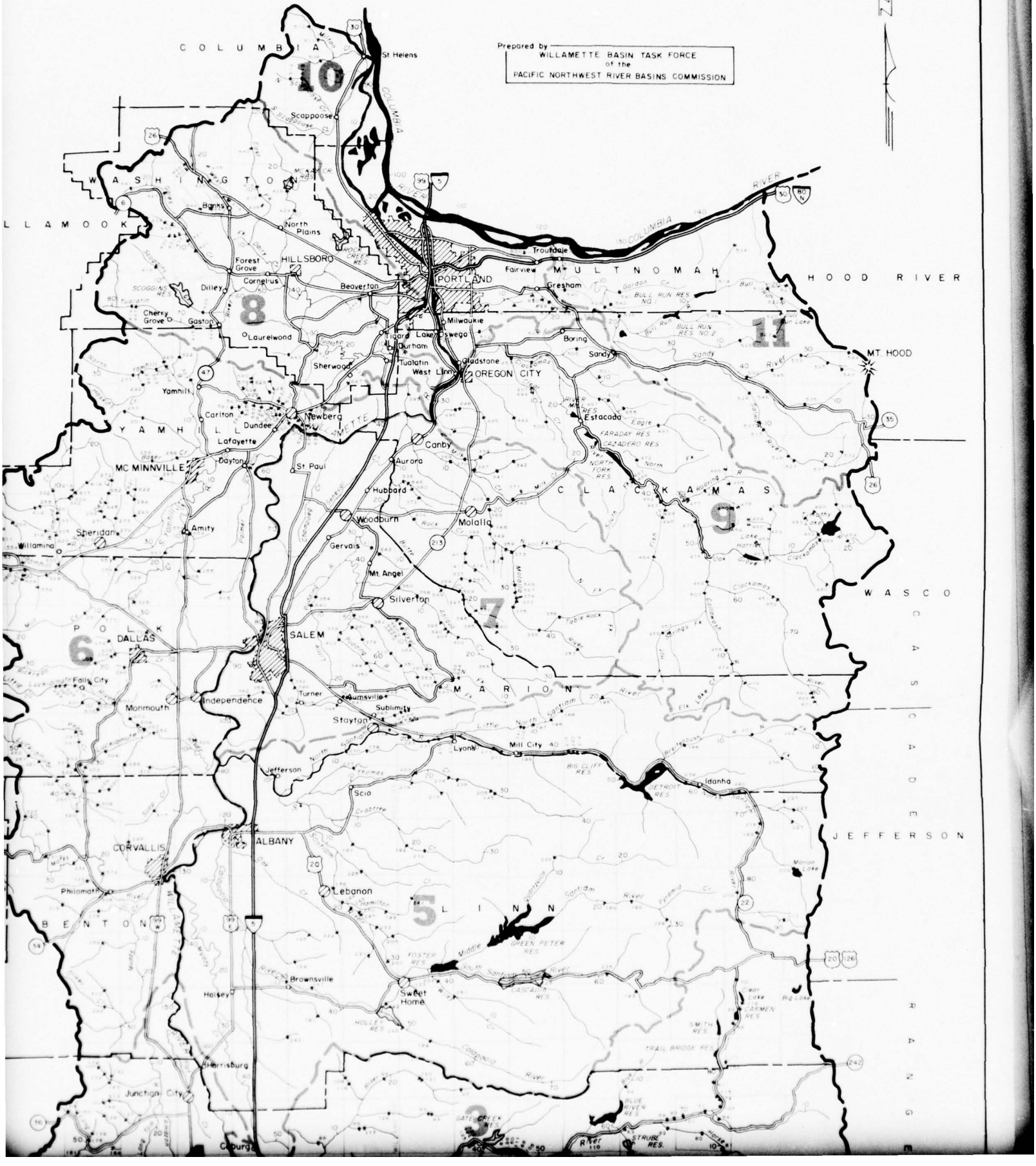
Table A-1 in Addendum A to Appendix E, Flood Control, is a listing of about 130 potential storage projects which survived the screening process. It shows site location, tributary drainage area, the amount of storage which would provide at-site control of a 100-year flood, and approximate cost per acre-foot for that amount of storage. All told, if developed to the levels shown, those sites would provide more than 5 million acre-feet of storage space.

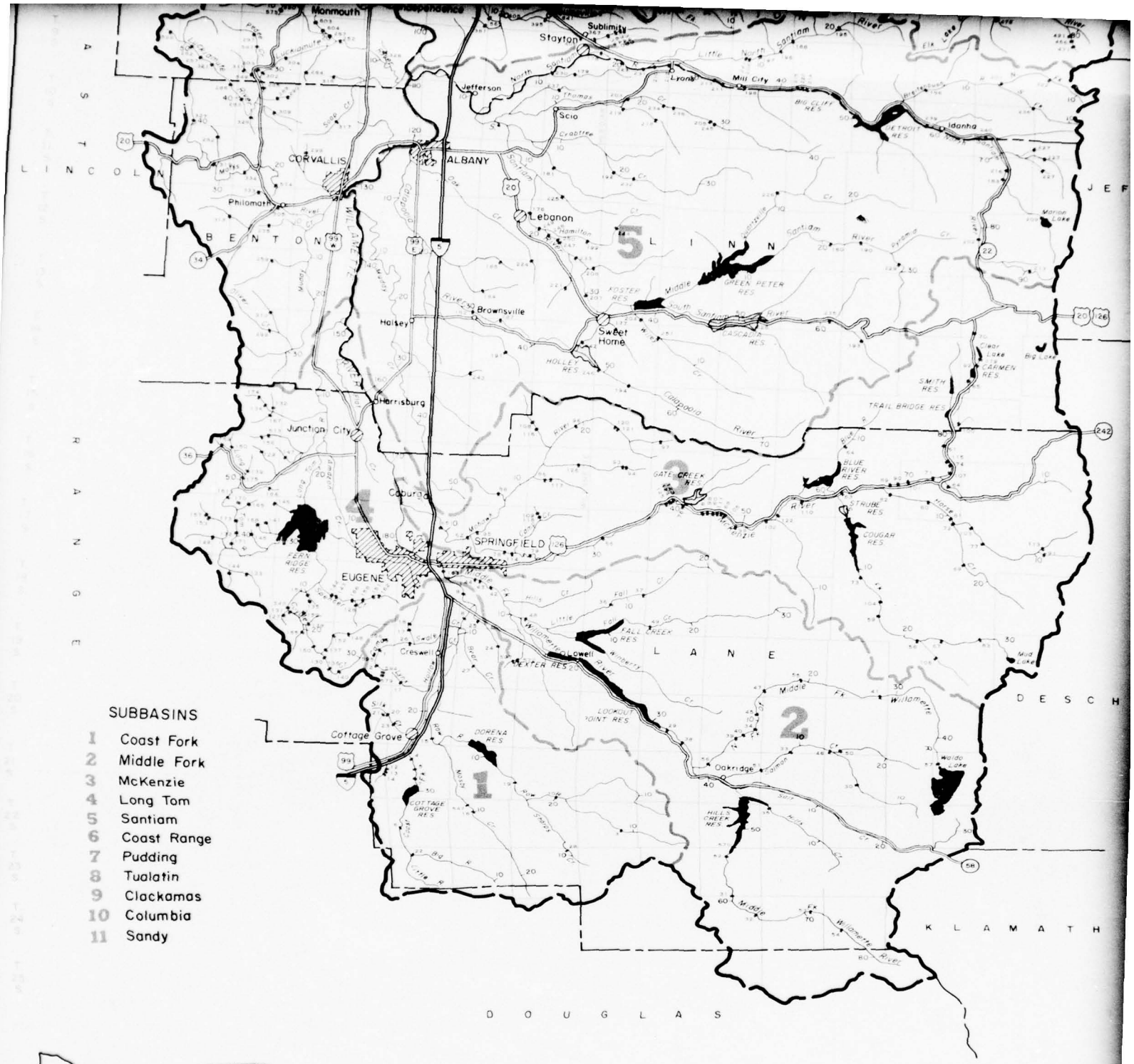
The project sites shown are ones which apparently would be physically feasible. However, some of the sites are located in areas from which runoff is or will be controlled by existing, authorized, and assured projects. For those latter sites, future development would have to be principally on the basis of increased need for conservation of flood flows now only delayed in passing.

The location of the projects listed in Appendix E is identified by site number, and by Section, Township, and Range. The site numbers shown may be used, with reference to Map IV-1, to permit location with respect to other projects shown on that map.

Screening of single-purpose alternative means of meeting functional needs shown in Appendixes D through L was done by the multiagency committees which prepared those appendixes. Study and consideration of alternatives by those committees, in increasing detail as the study


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WASHINGTON
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CLATSOP
LINCOLN
BENTON
POLK
YAMHILL
MARION
LINN
CLACKAMAS
MULTNOMAH
HOOD
JEF
10
8
6
5
7
9
11
St Helens
Scappoose
Hillsboro
North Plains
Forest Grove
Cornelius
Dilley
Cherry Grove
Gaston
Laurelwood
Beaverton
PORTLAND
Troutdale
Fairview
Gresham
Milwaukie
Lake Oswego
Tigard
Durham
Tualatin
West Linn
Gladstone
OREGON CITY
Boring
Sandy
Estacada
Sherwood
Yamhill
Carlton
Dundee
Newberg
Lafayette
Dayton
McMINNVILLE
St Paul
Canby
Aurora
Hubbard
Woodburn
Molalla
Sheridan
Amity
Willamina
Gervais
Mt Angel
Silverton
DALLAS
SALEM
Falls City
Monmouth
Independence
Turner
Aumsville
Sublimity
Stayton
Mill City
Lyons
Jefferson
Scio
Idanha
CORVALLIS
ALBANY
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Harrisburg
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COLUMBIA RIVER
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MULTNOMAH
HOOD RIVER
WASCO
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St Helens
Scappoose
Banks
North Plains
Forest Grove
HILLSBORO
Cornelius
Dilley
Beaverton
PORTLAND
Troutdale
Fairview
Gresham
Cherry Grove
Gaston
Laurelwood
Tigard
Lake Oswego
Milwaukie
Durham
Tualatin
West Linn
Gladstone
OREGON CITY
Boring
Sandy
MT. HOOD
Sherwood
Yamhill
Carlton
Dundee
Newberg
Lafayette
Dayton
MC MINNVILLE
Canby
Aurora
Estacada
St Paul
Hubbard
Woodburn
Molalla
Sheridan
Amity
Willamina
Gervais
Mt. Angel
Silverton
SALEM
DALLAS
Falls City
Monmouth
Independence
Turner
Jefferson
Scio
Stayton
Sublimity
Lyons
Mill City
Idanha
CORVALLIS
ALBANY
Philomath
Lebanon
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Cottage Grove
Detroit Res.
Big Cliff Res.
Green Peter Res.
Foster Res.
Hills Creek Res.
Trail Bridge Res.
Smith Res.
Blue River Res.
Gate Creek Res.
Struble Res.



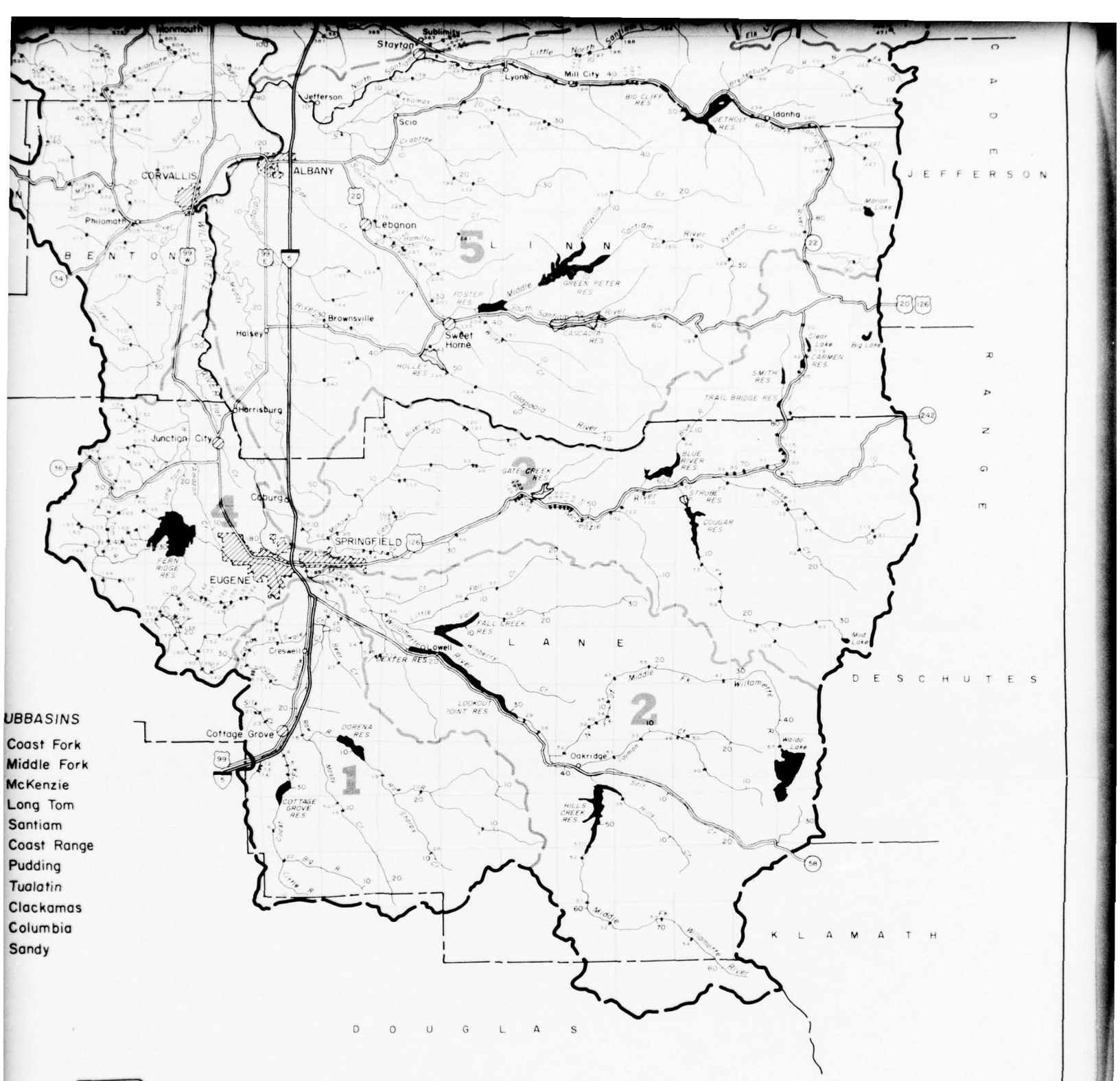
MAP IV-1

WILLAMETTE BASIN STU

OREGON

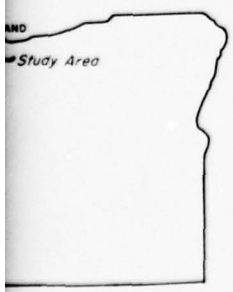
POTENTIAL STORAGE S

1967



SUBBASINS

- Coast Fork
- Middle Fork
- McKenzie
- Long Tom
- Santiam
- Coast Range
- Pudding
- Tualatin
- Clackamas
- Columbia
- Sandy



SUBAREAS

- Upper
- Middle
- Lower

LEGEND

- EXISTING RESERVOIR
- AUTHORIZED OR ASSURED RESERVOIR
- POTENTIAL STORAGE SITE

NOTE: Storage site numbers refer to addendum G.

MAP IV-1

WILLAMETTE BASIN STUDY

OREGON

POTENTIAL STORAGE SITES

1967

6 0 6 12

SCALE IN MILES

progressed, was an essential element of the screening process. The resulting data, however, are too voluminous for repetition in this appendix. Parts IV of those functional appendixes show details of single-purpose alternatives which survived committee screening and are subsequently mentioned herein.

Formulation Studies

Ground rules for plan formulation are discussed in the preceding section on Procedures and Criteria for Planning.

Initial matchings of needs and potentials were on the basis of physical (hydraulic) analysis only. Subsequently, when the more effective and apparently more favorable alternative combinations of projects had been identified for subbasins and the entire basin (and as benefit data became available), economic analyses were made. In the more favorable alternative basin-system plans, existing and assured projects were considered on the basis of operation as at present and operation under modified schedules.

The initial listing included 87 potential storage sites. It showed site location, agency making studies, average annual runoff at the site, the probable range of storage capacity to be considered, and related information.

The listing was a product, to that time, of screening which covered some 600 potential sites, as shown on Map IV-1. Screening was done cooperatively by the Soil Conservation Service, Bureau of Reclamation, and Corps of Engineers. It had consisted, at that time, of at least map evaluation, field investigation, and preparation of preliminary cost estimates for all potential projects which warranted such coverage. The preliminary cost estimates covered a range of storage capacities for each site and permitted a ranking of sites, in order of approximate cost per acre-foot, to be made. The projects shown are those which, initially and in advance of detailed needs data, appeared to provide reasonable areal distribution of capability and to be physically and possibly economically feasible.

On the basis of information in the listing, the various functional committees and the Federal and State resource agencies were able to better direct their activities toward needed end products. Also, particularly where overall resource programs would be alternative to

or adversely affected by projects, they were inspired to explore and outline program possibilities as soon as practicable.

BASIN-SYSTEM ANALYSIS

Basin-system analysis was a basic element of the two-part approach to formulation of the major-projects segment of the comprehensive basin plan. Combined with subbasin analyses and including the results of watershed analyses, it provided a basis for evaluation of basin-wide effects of potential storage projects.

Basin-system analysis considered the needs for, and the effects of, system operation of major storage reservoirs in the nine subbasins in the Willamette River drainage basin portion of the total study area. It also included studies of the effects of watershed project storage, both in subsystems and as a part of the overall basin storage system.

Consideration also was given to the possibility of structural modification of existing reservoirs, and to the inclusion of single-purpose structural and nonstructural measures to supplement or complement system storage.

The needs and other basic data used in subbasin and basin-system analyses were from the same sources. Basin-system analyses, however, covered only the nine upstream subbasins--the Willamette River drainage basin--in which major reservoirs must be operated as a system in consideration of basin-wide needs. Thus, coordinated and concurrent analyses were made at watershed and subbasin levels for all subbasins in the total study area, and at basin-wide level for the nine subbasins in the Willamette drainage proper.

The following subparagraphs discuss the basin-system aspects of plan formulation and illustrate the first system approximation, the principal intermediate step, and the end product of system analysis. It should be noted that the results of basin-system storage analysis generally are reflected in the subsequent discussion of subbasin analyses. Thus, the final consolidation of results of the two-part approach was simple and posed no unexpected problems.

First Storage System Approximation

The first approximation of a basin-wide storage system to meet projected needs was developed principally on the basis of known flood control needs, anticipated conservation needs, and site potentials. Selection of that basis for initial approximation was reasonable in consideration of data availability from past studies and ability to make seasonal joint use of storage space for conservation purposes.

Tentative storage needs at individual projects, as defined for that first approximation, generally were about twice the amounts shown in Table A-1 of Addendum A to Appendix E for control of a 100-year flood. That arbitrary definition made allowance for anticipated, but as-yet-unknown, total basin-wide conservation needs. For potential Public Law 83-566 watershed storage projects, however, more specific project sizing was developed to meet local watershed needs.

The result, as shown in Table IV-2 was a tentative and preliminary system consisting of 63 potential early-action and 44 potential long-range storage reservoirs. Those reservoirs would have provided total usable storage capacities of about 2,340,000 and 2,610,000 acre-feet, respectively. Table IV-3 illustrates, for representati e gaging stations only and in terms of flows and stream stages, the degree of flood control service which would have been provided, based on occurrence of a 100-year flood.

Initial Refinements

Information on the first tentative system superseded the initial listing of projects prepared in 1966. That information was furnished to appendix committees and all cooperating individuals and agencies. Their responses were considered in developing successive basin plan approximations, and data related to those approximations were used in continued development of the functional appendixes. Each new approximation was made in consideration of data from subbasin analyses, hydraulic system analyses, and concurrent evaluations of degree of service provided in individual functional fields, to the extent possible as needs data were developed. As refinements in plan progressed, the agencies involved--both construction and resource-oriented--met from time to

Table IV-2
First storage system approximation 1/
potential new reservoirs

Subbasin & Reservoir	Site No.	Stream	Probable Cap. Acre-feet E-A 2/	Probable Cap. Acre-feet L-R 3/	Surface Area Acres E-A 2/	Surface Area Acres L-R 3/
1, Coast Fork:						
Dorena 4/	-	Row River	10,000 4/	-	60 4/	-
Abrams	547	Mosby Cr.	90,000	-	1,050	-
N. Fk. Camas Sw.	17	Camas Swale Cr.	6,400	-	274	-
C. Fk. Trib.	25	Unnamed	9,000	-	325	-
Camas Swale	26	Camas Swale Cr.	20,000	-	820	-
Disston	10	Row River	-	140,000	-	1,315
Cottage Gr. #3	6	Coast Fk Will R.	-	58,000	-	1,140
Silk Creek	23	Silk Cr.	-	13,300	-	450
Subtotals			135,400	211,300	2,529	2,905
2, Middle Fork:						
Rattlesnake	572	Rattlesnake Cr.	2,400	-	60	-
Upper N. Fk.	55	N. Fk. Mid Fk	-	76,000	-	810
L. Fall Cr.	37	L. Fall Cr.	-	20,400	-	360
Subtotals			2,400	96,400	60	1,170
3, McKenzie:						
Horse Creek	81	Horse Cr.	115,000	-	840	-
Foley Ridge	71	McKenzie R.	-	260,000	-	2,120
Thurston	114	McKenzie R.	-	475,000	-	8,100
U. Mohawk #2	121	Mohawk R.	-	24,500	-	275
Shotgun Cr.	116	Shotgun Cr.	-	12,650	-	275
Subtotals			115,000	772,150	840	10,770
4, Long Tom:						
Upper Noti	172	Long Tom R.	60,000	-	2,200	-
Battle Creek	548	Coyote Cr.	70,000	-	2,440	-
Ferguson Cr.	134	Ferguson Cr.	8,770	-	154	-
Ferguson	167	Trib. Ferg. Cr.	5,700	-	133	-
Bear Creek	129	Bear Cr.	2,500	-	107	-
Gillespie Cor.	137	Fox Hollow Cr.	10,500	-	322	-
Owens Creek	573	Owens Cr.	8,200	-	130	-
Bunker Hill	130	Coyote Cr.	10,000	-	410	-
Poodle Cr.	157	Poodle Cr.	-	14,300	-	320
Log Pond	149	Elk Creek	-	20,000	-	720
Subtotals			175,670	34,300	5,896	1,040

Table IV-2 (Cont'd)

Subbasin & Reservoir	Site No.	Stream	Probable Cap. Acre-feet E-A 2/	L-R 3/	Surface Area, Acres E-A 2/	L-R 3/
5, Santiam:						
Jordan	203	Thomas Cr.	140,000	-	2,390	-
Lyons	241	L.N. Sant. R.	204,000	-	2,100	-
Sucker Slough	237	Sucker Sl.	7,200	-	395	-
Courtney Cr.	191	Courtney Cr.	6,350	-	162	-
L. Muddy Cr.	243	L. Muddy Cr.	3,390	-	88	-
Upper Wiley	251	Wiley Cr.	-	98,000	-	1,660
Sawmill	232	Crabtree Cr.	-	113,000	-	830
Bear Br.	179	Bear Br.	-	16,800	-	490
Oak Cr.	224	Oak Cr.	-	11,100	-	250
Hamilton Cr.	244	Hamilton Cr.	-	12,000	-	330
Subtotals			360,940	250,900	5,135	3,560
6, Coast Range						
Wren	334	Marys R.	145,000	-	4,000	-
Pedee	302	Luckiamute R.	187,000	-	4,140	-
Agency	253	S. Yamhill R.	93,000	-	2,680	-
Buck Hollow	261	Willamina Cr.	125,000	-	1,435	-
Pike	306	N. Yamhill R.	105,000	-	1,460	-
Moores Valley	292	Haskins Cr.	25,000	-	625	-
Spring Valley	315	Spring Valley Cr.	4,800	-	197	-
N. Fk. Ash	296	N. Fk. Ash Cr.	3,100	-	124	-
M. Fk. Ash	291	M. Fk. Ash Cr.	3,000	-	190	-
Staats Cr.	316	Staats Cr.	3,600	-	205	-
Sulphur Spgs.	317	Soap Cr.	13,000	-	320	-
Beaver Cr.	259	Beaver Cr.	13,000	-	340	-
Oliver Cr.	299	Oliver Cr.	9,600	-	259	-
Reese Cr.	310	Reese Cr.	9,600	-	320	-
Black Rock	260	L. Luckiamute R.	17,000	-	286	-
Teal Cr.	550	Teal Cr.	25,000	-	461	-
Palmer Cr.	300	Palmer Cr.	7,800	-	473	-
Salt Cr.	576	Salt Cr.	3,600	-	135	-
Salt Cr.	558	Salt Cr.	8,400	-	682	-
W. Fk. Salt Cr.	577	W. Fk. Salt Cr.	9,500	-	143	-
Chehalem	578	Trib. Chehalem Cr.	2,400	-	66	-
Chehalem	581	Trib. Chehalem Cr.	2,300	-	132	-
Spring Brook	580	Spring Br.	2,640	-	152	-
Lewisville	287	L. Luckiamute R.	-	120,000	-	4,300
Dallas	268	Rickreall Cr.	-	50,000	-	655
Upper Fairdale	277	N. Yamhill R.	-	35,000	-	680
Panther Cr.	301	Panther Cr.	-	19,450	-	340
Baker Cr.	256	Baker Cr.	-	14,600	-	340
Lower Muddy	293	Muddy Cr.	-	18,400	-	600
Tindle Cr.	318	Tindle Cr.	-	11,700	-	275

Subbasin & Reservoir	Site No.	Stream	Probable Cap. Acre-feet E-A 2/	Probable Cap. Acre-feet L-R 3/	Surface Area Acres E-A 2/	Surface Area Acres L-R 3/
6, Coast Range (Cont'd) :						
Agency Cr.	254	Agency Cr.	-	25,000	-	310
Vincent Cr.	328	Vincent Cr.	-	13,700	-	480
E. Fk. Willamina	582	E.Fk Willamina Cr.	-	21,170	-	380
Ead Cr.	585	Ead Cr.	-	11,700	-	180
Cosper Cr.	583	Cosper Cr.	-	14,300	-	310
Rowell Cr.	584	Rowell Cr.	-	26,600	-	380
Pedee Cr.	587	Pedee Cr.	-	25,000	-	590
Deer Cr.	586	Deer Cr.	-	35,900	-	940
Subtotals			818,340	442,520	18,825	10,760
7, Pudding:						
Dickey Bridge	348	Molalla R.	330,000	-	2,860	-
Grange	352	Silver Cr.	68,000	-	620	-
Selah	386	Pudding R.	22,000	-	1,380	-
Drift Cr.	410	Drift Cr.	9,000	-	313	-
Ebner	350	Pudding R.	5,200	-	255	-
Jefferson Rd.	358	Battle Cr.	2,700	-	104	-
Miller	367	Mill Cr.	5,950	-	245	-
Beaver Cr.	407	Beaver Cr.	21,200	-	1,000	-
Coal Cr.	569	Butte Cr.	-	60,000	-	695
S. Fk. Silver Cr.	593	S.Fk. Silver Cr.	-	24,600	-	510
Subtotals			464,050	84,600	6,777	1,205
8, Tualatin:						
Gales Cr.	420	Gales Cr.	86,000	-	1,860	-
Gaston	422	Tualatin R.	66,000	-	1,700	-
W. Fk. Dairy	449	Trib. W.Fk.Dairy	8,900	-	172	-
Tolke Canyon	435	Witcher Cr.	6,100	-	128	-
Bledsoe Cr.	438	Bledsoe Cr.	8,000	-	378	-
E. Fk. Dairy Cr.	440	E.Fk. Dairy Cr.	22,100	-	322	-
Fanno Creek	448	Trib. Fanno Cr.	2,760	-	235	-
E. Fk. Dairy Cr.	417	E.Fk. Dairy Cr.	-	43,000	-	980
Gales Creek	441	Gales Cr.	-	14,500	-	240
Forest Dale	418	Tualatin R.	-	26,000	-	210
McFee Creek	443	McFee Cr.	-	12,500	-	210
Subtotals			199,860	96,000	4,795	1,640
9, Clackamas:						
Big Bottom	451	Clackamas R.	-	200,000	-	2,080
Upper Austin Pt.	507	Collawash R.	-	270,000	-	2,240
Clear Creek	467	Clear Cr.	-	93,000	-	1,720
Eagle Creek	497	Eagle Cr.	-	21,000	-	300
Subtotals			-	584,000	-	6,340

Table IV-2 (Cont'd)

Subbasin & Reservoir	Site No.	Stream	Probable Cap. Acre-feet E-A 2/	Probable Cap. Acre-feet L-R 3/	Surface Area Acres E-A 2/	Surface Area Acres L-R 3/
10, Columbia:						
Trib. Johnson Cr.	515	Trib. Johnson Cr.	3,260	-	178	-
Trib. Johnson Cr.	591	Trib. Johnson Cr.	3,500	-	290	-
Trib. Johnson Cr.	592	Trib. Johnson Cr.	3,600	-	165	-
Fairview Creek	566	Fairview Cr.	1,740	-	200	-
Milton Creek	510	Milton Cr.	-	10,000	-	300
N. Scappoose Cr.	513	N. Scappoose Cr.	-	18,200	-	535
Subtotals			12,100	28,200	833	835
11, Sandy:						
Linney	526	Salmon R.	58,600	-	650	-
Gordon Cr.	541	Gordon Cr.	-	10,500	-	110
Subtotals			58,600	10,500	650	110
Basin-wide totals:						
Early-action			2,342,360		46,340	
Long-range			2,610,870		40,335	
			4,953,230		86,675	

1/ *Preliminary; see table V-2 for final storage plan.*
2/ *Early-action.*
3/ *Long-range.*
4/ *Enlargement of existing reservoir.*

Table IV-3

Flood control effects for first approximation, basin storage plan 1/

Stream and Station	Regulation Goal 2/ Stage, Feet	Regulation Goal 2/ Discharge cfs	With the base system 3/ Stage, Feet	With the base system 3/ Discharge, cfs	Base system and new storage 1/ Stage, Feet	Base system and new storage 1/ Discharge, cfs
Coast Fork at Goshen	11.7	12,000	17.5	36,000	14.9	20,300
Middle Fork at Jasper	9.3	20,000	9.3	20,000	8.3	16,000
McKenzie R. at Coburg	8.7	24,000	15.9	70,000	10.0	29,700
Marys R. at Philomath	16.6	3,000	20.8	14,500 4/	20.2	6,500
Santiam R. at Jefferson	13.2	35,000	22.0	135,000	19.0	80,800
Luckiamute R. at Suver	24.6	5,000	34.9	35,000 4/	28.1	8,900
S. Yamhill R. at Whiteson	37.5	13,000	47.5	49,000	43.7	30,300
Pudding R. at Aurora	20.1	5,000	30.2	30,000 4/	28.2	20,000
Molalla R. at Canby	9.8	12,000	16.5	42,000 4/	11.2	16,900
Willamette R.						
at Eugene	20.2	40,000	24.1	60,000	21.3	45,100
at Albany	19.2	60,000	31.7	150,000	19.7	62,550
at Salem	21.3	100,000	32.5	230,000	20.5	92,200
at Wilsonville	72.5	115,000	85.6	233,000	71.4	106,300

1/ As shown on Table IV-2; storage amounts for new projects are roughly twice the amount required for at-site control of a 100-year flood.

2/ Capacity which could be provided with minor work described herein as basin system channel improvement.

3/ As shown in Table IV-1.

4/ Natural flow; no base-system storage on this stream.

time with local groups and committees to discuss progress of the study. At those meetings information was presented on potential projects and programs, and local reactions were noted for consideration in continuing formulation studies.

Over the period in which successive refinements were made on the basis of physical analyses, data as to benefits in individual functional fields also became available. Those data, as they became available, contributed to decisions as to further successive adjustments and refinements to individual potential projects and the developing overall storage plan. Also, within the overall framework, it became increasingly apparent which of those projects should be selected for early action.

As the process of refinement and adjustment proceeded, it also became possible to make a reasonable identification of appropriate nonstorage projects and of complementary program needs.

By mid-1958, refinements and analyses had progressed sufficiently that a preliminary plan could be presented to the public.

Preliminary Plan

In August 1968, a preliminary plan was presented to the general public. The presentation included distribution of a handout sheet, Addendum D herewith, to all those in attendance, as well as to the Governor of Oregon. Copies subsequently were distributed widely by group representatives, the Willamette Basin Project Committee, and agency representatives. The handout sheet showed locations for all existing, assured, and potential early-action (short-range) storage projects. It showed a preliminary pertinent data summary for potential new developments and for a potential physical modification to an existing storage project. It contained a brief discussion of the programs which apparently would be in the early-action plan, and the possibility of plan changes as the study progressed. It also presented a summary of then-anticipated actions prior to study completion, and an invitation for public comment on the plan and participation in those actions.

As noted in preceding text on study chronology, public reaction to the preliminary plan was favorable. On that basis, further refinement of the preliminary plan, leading to consolidation, final refinements, and definition of the final plan, was continued.

Further Refinements

When the preliminary plan was presented, only partial economic analyses, based on incomplete benefit data, had been made. Further, such economic analyses as had been made were based on use of the then-current 3-1/4 percent Federal discount rate. With the advent in late December 1968 of the new formula which resulted in a 4-5/8 percent rate for Fiscal Year 1969, considerable additional work was required to update costs and benefits.

Other actions included additional system hydraulic analyses, as needs data were refined to investigate the desirability of alternative operating schedules; and further economic analysis, as additional and more accurate benefit data were furnished. Also, the plan formulation coordinator, working from the latest results of subbasin and basin-system analyses and using initial drafts of text, reviewed data used and plan formulation results with each functional committee. Responses to committee reactions and (in some cases) last-minute refinements in needs and benefit data resulted in final refinements and adjustments to the basin-system storage analysis.

Summary of Basin-System Storage Analysis

The overall storage plan selected on the basis of basin-system analysis differs from the final plan only to the extent discussed in subsequent text on consolidation and final refinements.

Other Basin-System Projects

Basin-system analysis, including inputs from the coordinated subbasin analyses and separate studies in the functional appendixes, resulted in selection of an extensive system of potential new storage reservoirs and appurtenant facilities. Those multiple-purpose projects, large and small, early-action and long-range, would supplement existing and assured projects. The resulting overall project system would provide a considerable degree of needs satisfaction.

Such a system, however, would not provide an adequate degree of basin-wide satisfaction of flood control, power, recreation, and navigation needs. Remaining needs in those fields would warrant the provision of additional essentially single-purpose developments. Some of those potential developments would have out-of-subbasin effects which require consideration in system analysis.

Included in the latter category are: (1) a navigation channel in Willamette River; (2) a system of channel improvements essential to continued effective flood control operation of storage projects; (3) Tualatin River channel improvement; (4) a modified Pudding River channel improvement; (5) an overall modification to the existing Fern Ridge Reservoir project; (6) several new single-purpose power projects; (7) storage in a series of small watershed projects responsive to local requests for assistance under PL 83-566; and (8) developments other than storage at multiple-purpose reclamation projects.

Information on formulation of those additional elements included or recognized in basin-system analysis is summarized in the following paragraphs.

Navigation Channel

The existing navigation project consists of an obsolete multiple-lift lock system at Willamette Falls and a partly-complete improved channel upstream from the falls. Depths in the improved channel are authorized to be attained by open-river works supplemented by increased flows from existing and authorized Corps of Engineers storage projects.

An existing authorization, in the River and Harbor Act of March 1945, provides for a new single-lift lock to replace the present structure. The authorized new lock would be adequate for projected navigation needs. The existing and authorized Corps storage projects could provide the flows originally established for the authorized navigation channel. Appendix I, Navigation, however, shows a potential for a material increase in tonnage of waterborne commodities, which could not be accommodated by the authorized navigation channel.

The presently authorized open-river channel would have to be deepened to accommodate the larger tugs and barges required for any significant increase in tonnage. Further, the overall basin study includes consideration of potential storage uses which might not be

compatible with present schedules for release of water for navigation purposes. Thus, restudy of navigation was necessary.

The restudy, completed to the extent discussed in Appendix I, indicated that, from a single-purpose navigation standpoint, an 8-foot-deep channel of varying width could be justified as far upstream as Albany. Based on use of a theoretical ideal trapezoidal channel section, it showed that flows in the order of 3,500 to 4,500 cubic feet per second would be adequate for navigation. Such flows are substantially less than provided for under existing authorizations.

For many reasons, however, it would be impracticable to attempt to provide and maintain such a channel section. Those reasons include the existence of a larger natural channel section, and the flood control need for an additional increment of channel capacity; fish-life needs for spawning and rearing, particularly with reference to the production of fall chinook salmon in the Salem-Corvallis reach; wildlife needs; needs for environmental preservation; and needs for recreation use and development, including the uncompleted Willamette Parkway System.

Additional detailed study of navigation developments will be made for a subsequent Corps of Engineers report to recommend project authorization. Pending completion of those studies final decisions cannot be made. It appears, however, that the expanded storage system proposed would be capable, in consideration of multiple needs to be served, of providing flows greater than those now established for navigation alone. On that basis, a useful and justifiable increment of channel depth probably could be provided by a combination of increased flows and appropriate open-channel improvements.

Basin-System Channel Improvement

The need for such a project is inherent in system operation of storage for flood control. The need has been demonstrated annually by operation of the existing multiple-purpose reservoirs, with less than 2 million acre-feet of total flood control space. It will be aggravated and expanded as new storage projects are placed in operation.

a. Problem. - The problem is a consequence of the need for rapid evacuation of stored water, through natural channels which are neither stable nor of adequate capacity. The necessary evacuation rates cause inundation of low-lying lands and improvements. Because of the

duration of evacuation flows, both bank and channel erosion are aggravated, with accompanying deterioration of channel conditions and loss of adjoining lands. Bank revetment provided to date under a separate authorization has ameliorated, but not solved, the problem in some cases.

Rapid evacuation of stored water is necessary because two or more floods, occasionally of major magnitude, often occur within a period of a few weeks. The 100-year flood of late December 1964 and the major flood of January 1965 typify the condition. To achieve a justifiable degree of flood control, the reservoir system must accommodate the runoff volume involved in such a sequence of flood events. It has not been possible, however, to justify the provision of enough storage space, in any of the projects, to contain all the excess runoff from such a sequence. Thus, flood control operating plans provide for rapid evacuation of stored water following each flood event. The time required for evacuation is a function of storage space to be evacuated, natural flows during the evacuation period, and available channel capacity. Both operating experience and study of past flood records indicate that evacuation should be accomplished in about 2 weeks. In contrast, evacuation of water stored during the flood of December 1964 required more than 4 weeks, and involved considerable inundation of low-lying lands and improvements. Even some areas along lower Long Tom River, where an improved channel was constructed about 20 years ago, were affected.

b. Alternative Solutions. - The evacuation-period inundation and erosion problems could be resolved, at least temporarily, by lengthening the evacuation period. To do so, however, would result in loss of reservoir control of subsequent storms. Concurrent with that effect, there would be continuing channel deterioration, land loss because of erosion caused by runoff from areas without storage control, and concurrent loss of overall reservoir control capability. Alternatively, the problem could be solved, and additional damage prevented, by provision of an appropriate system of channel improvements.

c. Proposed Project. - The latter alternative was selected. Such improvements would provide, and maintain, the needed increases in channel capacity to permit efficient flood control operation of existing, authorized, and new storage. Design would be based on

minimizing adverse impact on natural stream environment, accommodating the Willamette Parkway System, and minimizing adverse fish and wildlife effects. Conservative estimates indicate that at-site benefits would justify most of the cost of improvements required. Remaining justification would be served by appropriate assignment of a portion of the increment of reservoir benefits assured by channel work.

Tualatin River Channel Improvement

a. Problem. - Because of basin topography, flood flows are flashy and high-peaked in the headwaters of all major tributaries. Across the flat valley floor, however, the stream meanders in large oxbows and flows are restricted by brush and debris. Also, an existing diversion dam at about river mile 3.7 creates a low-water pool that extends upstream about 30 miles.

Under those conditions, inundation results from even minor freshets and a large flood plain remains ponded for long periods during most winter seasons. As a consequence of that natural storage, there are both flood damages and lack of adequate drainage. Any improvement which would eliminate that natural storage would have to be evaluated with respect to the effect of Tualatin flood flows on conditions in Willamette River during the flood peak and storage evacuation period on that stream.

A further consideration is that substantial recreation and fishery potentials would have to be considered in planning for flood control.

b. Alternative Solutions. - Reservoir control of floods would not solve the flood problem. Existing channel capacity is so limited that evacuation of stored water following a flood would not be possible without creating, for an extended period, flood problems roughly equivalent to those without storage.

Regulation of flood plain use, alone, would not provide a solution to the problem, particularly so far as damage to present improvements and losses due to impaired drainage are concerned. Neither would it develop the recreation potential of the channel.

Channel improvement, of itself, would reduce flood stages and facilitate drainage of agricultural lands. Also, it would permit

use of upstream reservoirs for more effective control of flood flows, and could be planned to include recreation development and preservation. Flood plain use regulation would be a desirable supplement.

c. Proposed Project. - In consideration of the foregoing, a plan of channel improvement for flood control, recreation, and environmental preservation was selected. The plan would provide capacity to contain up to about 10-year flood peaks, as regulated by authorized and proposed early-action storage reservoirs upstream. It would permit more efficient operation of those reservoirs for regulation of flood peaks. It would embody recreation development, preservation of selected environmental resources, and features to minimize adverse environmental effects and damages to fish and wildlife.

Additional studies as a basis for possible agency recommendation for authorization will have to include additional careful analysis of the effect of eliminating or reducing natural storage, so far as system operation of storage is concerned.

Pudding River Channel Improvement

Pudding River needs, problems, and potentials are generally similar to those just described for Tualatin River. In contrast, however, the entire stream in the flood plain is free flowing, through a meandering and debris-choked channel. There is no presently authorized storage development, but there is an authorization for channel improvement for flood control and major drainage.

In consideration of the recreational and environmental potentials of the channel, it is proposed that the existing authorization be modified. The modified plan would include appropriate development of recreation facilities at selected locations, and would provide for preservation of selected environmental resources and features to minimize adverse impact on environment and fish and wildlife.

As discussed above with respect to the Tualatin channel, additional system evaluation will be required to determine the downstream effects of eliminating or reducing natural storage in the subbasin.

Fern Ridge Modification

a. Existing Project. - The existing Fern Ridge project includes the dam and reservoir and the associated Long Tom channel, for flood control operation of storage, from the dam downstream to Willamette River. The project was placed in operation in December 1941 as the first of 14 Corps of Engineers multiple-purpose reservoirs now existing and/or authorized. Authorized primary project purposes are flood control and the storage of water for irrigation and navigation. Extensive recreation facilities have been provided, principally by the Corps and Lane County. Recreation usage, growing rapidly, now is about 1.3 million visitor-days annually.

b. Problem. - Because of the heavy recreational use, and the absence of any significant demand for irrigation supply, an interim operating schedule to facilitate recreational use was developed. That schedule provides, to the extent possible, for summer-long maintenance of a high pool level. However, evaporation alone exceeds the summer inflow and reduces water levels throughout the summer. Also, there is a requirement for maintaining flows in Long Tom River downstream from the dam. Further, available runoff during the filling season is not adequate to assure complete filling in all years. Thus, with the advent of a growing irrigation demand, the recreation potential of the project will be sharply reduced if no action is taken. Local interests would be strongly opposed to such reduction.

The problem of drawdown as related to recreation is aggravated by the fact that the pool is shallow, and that stumps left in the clearing operation reach almost to full pool level in some areas. Under those conditions, drawdown results in a rapidly receding shoreline and a danger to boaters.

c. Alternative Solutions. - There is only one logical course of action which would provide needed and authorized irrigation service, authorized flows for navigation, and a solution to the problem of decreasing recreation potential. That course is to provide a source of additional summer water supply for Long Tom Subbasin. A new supply in the order of 100,000 to 120,000 acre-feet would be required to offset completely the problems of failure to fill, evaporation, and withdrawals

for streamflow maintenance and authorized uses. Several alternative means of providing such a supply were considered. These consisted of: (1) modified operating schedules to facilitate dependable filling; (2) various means of diversion of natural flows, and possibly stored water, from Willamette River; and (3) development of additional storage in Long Tom Subbasin. Each of those alternatives would have both subbasin and basin-system effects.

(1) Modified operation to facilitate dependable filling would be effective only in one relatively minor aspect of the overall problem. However, that aspect has been the principal basis for most of the problems to date. During 28 years of operating experience, complete filling of conservation space has been attained in only 14 years. Most of the shortages have been minor, but shortages ranging from 25 to 50 percent occurred in 3 years. Coupled with the character of the reservoir, as already described, those shortages have created recreation problems.

The filling problem is a consequence of the need to reserve space for control of late-season floods. Development of a solution is complicated by the fact that both the occurrence of such floods and the ability to fill depend on as-yet-unpredictable late season rainfall. The basic solution would consist of initiating filling at an earlier date and/or filling more rapidly during the early part of the season before flows recede to seasonal lows. Either of those actions would entail the risk of being unable to provide effective control of late-season floods. Experience has shown that initiating annual filling prior to the presently scheduled date of 1 February would involve undue risk of losing flood control effectiveness. However, preliminary studies have shown that more rapid filling in February would be reasonably effective in reducing filling problems; this could be done without apparent undue risk from the flood control standpoint, either in Long Tom Subbasin or downstream along Willamette River. In years such as 1934 and 1941, however, the available runoff after 1 February would not permit improved filling under any operational schedule which would permit required maintenance of low-water flows in Long Tom River downstream from the dam.

Further study of Fern Ridge as a part of the basin system would have to be made, to confirm the lack of flood control problems, before a modified operation schedule could be adopted. Such study will be made for and discussed in a subsequent agency report.

(2) Diversion could be accomplished by either one or both of two possible means. The total supply of natural flow and stored water available in Willamette River apparently is adequate, but additional system studies will be required for confirmation. One method would be gravity diversion. The plan would utilize an abandoned mill race channel and a short section of new channel or conduit in Eugene, and the Amazon Creek channel from Eugene to the reservoir. The other would be a pumped diversion, downstream from Eugene. A channel or conduit would lead from the diversion point to the Amazon Creek channel.

Either alternative would permit water to be provided, in Fern Ridge Reservoir, to offset lack of filling capability, evaporation, and withdrawals. Neither would offset the need for authorized withdrawals for navigation. Assignment of the navigation responsibility to other storage would be required for that purpose, and the effect on the overall basin system would have to be evaluated.

Although there are uncertainties as to the relative desirability of these and other alternatives, it appears that diversion offers a good possibility for early action to solve at least part of the problem.

(3) Upstream storage would consist of separately described early-action and long-range projects. A part of the storage in the early-action Bunker Hill and Gillespie Corner Reservoirs at sites No. 130 and 137, respectively, could be used to offset withdrawals from Fern Ridge. Those reservoirs are elements of the proposed Coyote-Spencer Creek watershed project. Such use would be alternative to at-site development at Bunker Hill to provide for about 80,000 visitor-days of recreation use annually. In the order of 12,000 acre-feet of water could be made available from the two projects. Considering the possibility of at-site development at Bunker Hill for recreation, the prospect of significant assistance from those projects seems relatively poor. A part of the storage in the long-range Upper Noti Reservoir, at

site No. 172, also could be used to offset withdrawals from Fern Ridge.

Development of additional storage would provide the only means for offsetting demands for navigation withdrawals.

d. Proposed Modification. - Modification would consist of operational modification associated with expansion of the project to include facilities for diversion from Willamette River, and use of proposed early-action and/or long-range upstream storage projects as a source of additional water supply. The existing project plus those additions would be operated as a subsystem constituting an integral unit of the overall basin storage system. No physical modification to the existing project structures would be required.

The operational and physical elements of the modified project would be adaptable to step-by-step development, as warranted to meet growing needs. Operation could be modified as soon as detailed studies might show that course of action to be acceptable. Such modification, however, could provide no more than a partial solution to one aspect of the problem. Diversion from Willamette River, under some of the alternatives mentioned, should be considered for early action along with possible use of some storage from the proposed early-action watershed reservoirs.

Single-Purpose Power Development

Appendix J contains analyses, from a single-purpose standpoint, of various means for meeting a portion of the projected power needs. Included are potential single-purpose power projects, power developments which might be justifiable additions to potential multiple-purpose projects, pumped-storage developments, and thermal plants. Each of those potential projects would have to be evaluated with respect to effects on operation of the basin-wide storage system.

The Appendix J studies include a showing of seven single-purpose projects with benefit-to-cost ratios, at 4-5/8 percent interest in the cost analysis, in excess of 1 to 1. Those seven projects were selected, on the basis of basin-system considerations and in advance of receipt of preservation recommendations, for early action; the others would be long-range elements of the plan.

Pumped-storage power is stated in Appendix J to be needed after 1990 and to require additional study to show how it would fit into the region's future load pattern. The nine most-favorable prospects listed in Appendix J were included in the plan as long-range elements. The additional study required will have to include consideration of any effects on the overall basin system of storage reservoirs.

Small Watershed Projects

Twenty-six small watershed projects, formulated under PL 83-566 to Department of Agriculture standards in response to local request, also were taken into account in the basin-system aspects of plan formulation. Sixteen of those projects include storage capability for satisfaction of downstream requirements. As subsequently discussed in Part V, some of the storage elements in those projects present an alternative to use of existing Federal storage as a source of irrigation supply, or to development under other programs or plans.

Multiple-Purpose Reclamation Projects

A total of seven divisions and phases of potential and authorized projects, studied under the lead of USBR, were taken into consideration in system analyses. Those projects include 11 potential reservoirs, with about 843,000 acre-feet of storage space. Included are three projects which would rely, to some extent or in total, on existing and authorized Federal storage or natural flows. Both the existence of potential reservoirs and the needs which could be served by existing and authorized storage were recognized in system storage analyses. Also recognized was the fact that certain small watershed reservoir projects would provide a water supply, for irrigation, alternative to use of existing and authorized Federal storage. Such alternatives would be of minor consequence, so far as the basin-wide system of reservoirs would be concerned. They were recognized, and treated, as local-choice options alternative to the presently authorized use of upstream storage.

SUBBASIN ANALYSES

Subbasin analysis provided a necessary and useful tool in the plan formulation process. The adopted approach consisted of analyzing each subbasin in an orderly manner: its resources, economy, needs, possible solutions, and a plan best suited to meet its needs. Although the approach was primarily on a subbasin basis, watershed and downstream needs were considered and plan elements which could best contribute toward meeting those needs were selected.

The following text contains a discussion of the subbasin aspects for each of the 11 subbasins.

The needs and other basic data used in subbasin analysis, and a summary of storage project accomplishments in the subbasin, are shown in the table accompanying text on each subbasin. Summary tables V-6 through V-14 show, for each function and generally by subbasins, the degree to which all projects in the plan would satisfy projected basin needs. Descriptions of the projects involved, as finally incorporated in the comprehensive basin plan, are contained in Part V together with a basin summary of plan effects and impacts.

SUBBASIN 1 - COAST FORK



Subbasin 1, Coast Fork

The Setting

Subbasin 1 constitutes about six percent of the basin area. It consists of the entire drainage area of Coast Fork Willamette River. Flows from the subbasin affect conditions along the entire length of Willamette River. Heading at low elevations in the Calapooya Mountains, its seasonal streamflow pattern is characterized by a wide variation between flood peaks and small sustained low-water flows. The ground water resource has only a small potential for increased use. There is only one small natural lake. Forest lands cover 84 percent of the subbasin and a considerable portion are privately owned. Present and projected population density is about one-third of the basin average.

The existing Federal reservoirs, Dorena on Row River and Cottage Grove on the Coast Fork, are authorized for flood control and to store water for navigation and irrigation. Some recreation facilities have been provided. Those reservoirs cannot provide optimum fish flows at Goshen. Neither could they provide minimum fish flows after about 1980 if irrigation demand increases as expected. High streamflow temperatures

downstream from the dams during the late season cannot be significantly improved by modification of existing structures. Additional storage could provide potential for a resident trout fishery, lower water temperatures in streams, and an irrigation supply for the Camas Swale Game Management area.

The existing reservoirs provide only about one-half of the effective storage required to control a 100-year flood at Goshen--about 100,000 acre-feet of additional storage space, properly located upstream, would be required for that purpose. Further, they provide control of runoff from only about 60 percent of the watershed. As a consequence, average annual damages of about $205,000 are expected to more than double by 2020. Mosby Creek is the only large tributary with no control, so storage should be considered for that stream. Since neither of the existing reservoirs is large enough to control a 100-year flood at the site, consideration should be given to enlarging them or providing additional storage upstream. Also, there is a need for stabilization of the channel downstream from the dams to facilitate reservoir operation for flood control.

Available ground water supplies, together with authorized irrigation use of the existing Federal reservoirs, would be adequate in quantity to meet projected irrigation requirements although some locational deficiencies exist. Unless other uses are found for existing storage, both sources should be utilized to the maximum extent practicable before additional Federal funds are expended for irrigation storage.

Municipal and industrial water rights and supplies appear nearly adequate to meet 2020 needs. About 1,000 acre-feet of storage and increased filter plant capacity will be required by Cottage Grove. Creswell is expected to rely on ground water and will need additional rights.

Surpluses in both water-related and nonwater-related recreation capacity will exist within the subbasin until sometime after 2000. However, additional facilities will be required--enough to provide 2,848,000 additional recreation days of use annually by 2020. Also, consideration must be given to Recreation Committee recommendations that Coast Fork Willamette River, except for existing projects, and Mosby Creek be left in natural conditions under an environmental management program.

Because flows required for water quality purposes are considerably less than the minimum fish flow requirements, additional storage is not needed specifically for water quality control in the subbasin.

Subbasin Rationale

There appears to be no potential for power development, or navigation service other than storage and release of water, in the subbasin. There are, however, significant subbasin needs for additional flood control and for fish life flows. Also, basin-system studies show major downstream needs for flood control and for multiple-use flow augmentation. Those needs could be satisfied only by additional storage development. A locally-instituted program of flood plain use regulation would be an essential adjunct to storage, to prevent future increases in flood damage potential.

The following discussion shows pertinent subbasin rationale and outlines proposed development features. Individual program and project descriptions are contained in Part V. Table IV-4 presents a statistical summary in units as used in subbasin analysis, of water-related needs and storage accomplishments in the subbasin as of 2020.

a. Early-action features. - Early-action features were selected on the basis of subbasin needs plus, for storage projects, consideration of service which could be rendered to downstream needs. The early-action features allow for a substantial local irrigation development from ground water. The principal features included are: (1) modification to increase flood control capability for one existing Federal reservoir, (2) two small watershed projects, and (3) basin-system channel improvements associated with flood control operation of storage. Other items include the local irrigation developments and additional recreation facilities. Although there is need for enlargement of Cottage Grove Reservoir, that work apparently could not be justified and no physical changes are proposed. However, reauthorization of both reservoirs to include recreation, fish and wildlife, water supply, and water quality improvement as project purposes would be appropriate.

(1) Dorena Reservoir modification would consist of provision of spillway gates to permit controlled use of an increment of about 10,000 acre-feet of storage space for flood control. The project should be reauthorized to include that work, as well as to make fish

Table IV-4

Projected water-related needs and storage accomplishments
Subbasin 1 - Coast Fork, 2050

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments										
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Navigation Flow, cfs	Power Cap., kw	Recreation, 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs 3/	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. Projected Subbasin Needs	-	-	-	-	-	*448*	*480*	*864*	*194,000 4/*	*888*	*51,000*	*11,400*	*0 5/*	*N/A 6/*	*5,108*	*5,108*	*30-80 8/*
B. Presently Assured Accomplishments:	*110,800*	-	*3,000*	-	-	*160*	*0*	*120*	*96,500 4/*	*388*	*40,800*	*10,400*	*N/A 5/*	*0*	*2,348 7/*	*1,370*	*8/*
1. Natural flow and small storage	N/A	-	N/A	-	-	N/A	N/A	120	-	-)		17,400	-	-)		-	-
2. Storage reservoirs:										)				)			
Dorena	77,500	-	1,840	FC,N,I	WS,R,F&W,WQ	N/A	N/A	-	70,500	265)	38,100 9/	-	-	-)	2,348	790	-
Cottage Grove	33,000	-	1,160	FC,N,I	WS,R,F&W,WQ	N/A	N/A	-	30,000	104)		-	-	-)		580	-
3. Groundwater	-	-	-	-	-	-	-	-	-	-	2,700	3,000	-	-	-	-	-
C. Total Residual Needs	-	-	-	-	-	*288*	*480*	*984*	*98,500 4/*	*170*	*10,800*	*1,000*	*0*	*N/A 6/*	*(+840)*	*788*	*0*
D. New Storage Accomplishments:	*159,300*	-	*3,380*	-	-	*343*	*480*	*0*	*119,000 4/*	*93*	*10,800*	*1,000*	-	*0*	*1,021*	*384*	*0*
1. Early-action reservoirs:																	
Dorena modification	10,000	-	60	-	FC	-	-	-	10,000	-	0	0	-	-	-	-	-
Cloverdale, site No. 25	9,000	2,800	330	-	I,R,O 10/	41 11/	-	-	12/	-	5,100	0	-	-	66	28	-
N. Fk. Camas Swale, site No. 17	6,400)	4,050	270	-	I,O 10/	-	-	-	-	-	4,300	0	-	-	-	-	-
Camas Swale, site No. 26	16,000)		800	-	FC,R,O 10/	100 11/	-	-	4,000	16	-	0	-	-	160	130	-
Subtotals	41,400	-	1,460	-	-	141 11/	-	-	14,000	16	9,400	-	-	-	226	158	-
2. Long-range reservoirs:																	
Abrams, site No. 547	50,000	-	660	-	FC,R,F&W	83 11/)	450	-	45,000	66	-	-	-	-	330	130	-
Dixston, site No. 10	90,000	-	950	-	FC,R,F&W,WS	119 11/)		-	70,000	-	-	1,000	-	-	475	95	-
Silk Cr., site No. 23	7,900	-	310	-	FC,I,O 10/	-	-	-	3,400	11	800	-	-	-	-	-	-
Subtotals	147,900	-	1,920	-	-	202 11/		-	118,400	77	800	1,000	-	-	805	225	-
E. Year 2050 Conditions:																	
1. Subbasin storage totals	*199,800*	-	*6,880*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Unmet needs	-	-	-	-	-	*0*	*0*	*984 13/*	*0*	*77*	*0*	*0*	-	*N/A 6/*	*0*	*388 14/*	-
3. Additional capacity	-	-	-	-	-	48 15/	-	-	18,600	-	-	-	-	-	1,021	-	-

N/A Not available for subbasin or location.

1/ Additional data are shown in Part V.
2/ Additional study to be made; see Part V.
3/ At Goshen.
4/ Amount, effective at Goshen, for control of a 100-year flood.
5/ No need in subbasin; storage releases contribute to meeting Willamette River needs.
6/ Projections only, on a total-basin basis.
7/ Includes Willamette River.
8/ Requirements met by natural flows and releases for other purposes.
9/ Existing reservoirs operated under present authorizations; further study may result in some change.
10/ Space not fully assigned; some available for other purposes.
11/ Capacity based on 15% fish per surface acre; management practices discussed in Appendix D required for utilization of potential.
12/ Flood control effect limited to regulation incidental to filling for irrigation.
13/ Can be met by implementation of agreed management programs discussed in Appendix D, Fish and Wildlife.
14/ Can be met by implementation of programs presented in Appendix K, Recreation.
15/ At present angler success ratio; additional fish would be used, to the extent available.

and wildlife, recreation, water supply, and water quality improvement recognized project purposes.

(2) Small watershed projects are those for the Cloverdale and Camas Swale areas. They would be developed to meet needs and local desires for flood control and drainage, irrigation, and recreation, including reservoir fisheries where appropriate. In addition, depending on subsequent agency-local decisions, service might be provided to downstream needs for fish and wildlife, water supply, and water quality improvement. The two projects include three multiple-purpose storage reservoirs with an aggregate capacity of about 31,400 acre-feet and a total surface area of roughly 1,400 acres. In addition to storage and related facilities, the projects would include provisions to meet associated land treatment needs, about 4.3 miles of channel improvement to meet watershed needs for flood control and drainage, and an irrigation distribution system.

A reservoir at site No. 25 in the Cloverdale project would provide irrigation service alternative to use of upstream Federal storage authorized and presently available for that purpose. If that source were used, the multiple-purpose project at site No. 25 probably could not be justified. Final decision on the irrigation alternative ultimately will be made by local interests, unless the existing storage is assigned to a new use or uses.

Project facilities would reduce the average annual flood plain by about 1,080 acres, and provide an irrigation water supply to more than 3,200 acres. Provision would be made for initial annual recreation use in the order of 65,000 visitor days. Project reservoirs would provide 10 percent and 3 percent, respectively, of the drainage-area-control and flood control storage requirements at the downstream control point, Goshen, on Coast Fork Willamette River. Also included is about 6,850 acre-feet of storage capacity which could be used to satisfy about 16 percent of the summer flow augmentation requirement at Goshen. Specific assignments or sizing changes, as appropriate, will be made during preconstruction planning by project sponsors and concerned agencies, in consideration of potentials for enhancement of fish and wildlife as a project purpose.

(3) Basin-system channel improvement required for efficient operation of major subbasin reservoirs for flood control would be limited to channel stabilization during the early-action period. Operating experience has shown that the channels of Row River and Coast Fork Willamette River are unstable under present conditions. Even the small increment of flood control storage capability proposed for Row River would aggravate the problem on both streams.

(4) Other features consist principally of: (a) provision of private irrigation facilities, in the form of farm ponds, ground water development, and pumping facilities for use, under contract, of stored water from existing Federal storage; (b) a local program of flood plain use regulation to complement the effects of storage control of floods; (c) the proposed environmental management program for Coast Fork Willamette River and Mosby Creek with exceptions for the existing project, basin-system channel improvements, and the long-range Abrams Reservoir; (d) installation of six small group enterprise jobs on agricultural land involving channel improvement, dike construction, and improved drainage outlets; and (e) soil and water restoration measures at 33 identified locations on revested Oregon and California Railroad (O&C) forest lands.

b. Long-range features. - During the long-range period development would be directed principally toward meeting projected increases in needs for (1) flood control, within the subbasin and downstream; (2) fish and wildlife, also with out-of-subbasin aspects; (3) recreation, from the standpoint that service to downstream needs will cause rapid drawdown of existing reservoirs; and (4) environment, from the standpoint that the proposed early-action environmental management program would be in effect on Row and Coast Fork Willamette Rivers.

(1) Abrams Reservoir site on Mosby Creek is one of the two best possibilities in the subbasin to provide additional multiple-purpose storage development. Mosby Creek is the largest remaining uncontrolled tributary in the subbasin. If subbasin and downstream flood control and fish life needs are to be given a reasonable degree of service, a project ultimately must be developed. Thus, beyond the proposed early-action designation of Mosby Creek for inclusion in an

environmental management program, Abrams is included as a long-range element of the plan. It is recognized that decision for development will be subject to the results of further study of environmental impact as well as of development potential. Storage capacity probably should be in the order of 50,000 acre-feet to provide for flood control and fish life. Storage releases would provide improved fish habitat in Mosby Creek and temperature control downstream. Recreation facilities should be provided to permit utilization of site potential.

(2) Disston Reservoir site, on Row River upstream from Dorena Reservoir, is the second of two best subbasin possibilities for additional multiple-purpose storage. It would help to meet substantial flood control needs, in the subbasin and downstream. It would provide increased flows for fish life and, with proper operation, might facilitate reduction of release temperatures at Dorena. That same operation probably would facilitate maintenance of a full pool for recreation at Dorena for an increased time in each year. The reservoir probably would inundate the existing municipal water intake of the City of Cottage Grove. To satisfy a projected need for about 1,000 acre-feet of storage, the City may wish to contract for a water supply from the reservoir. In consideration of those factors, total capacity probably should be in the order of 90,000 acre-feet.

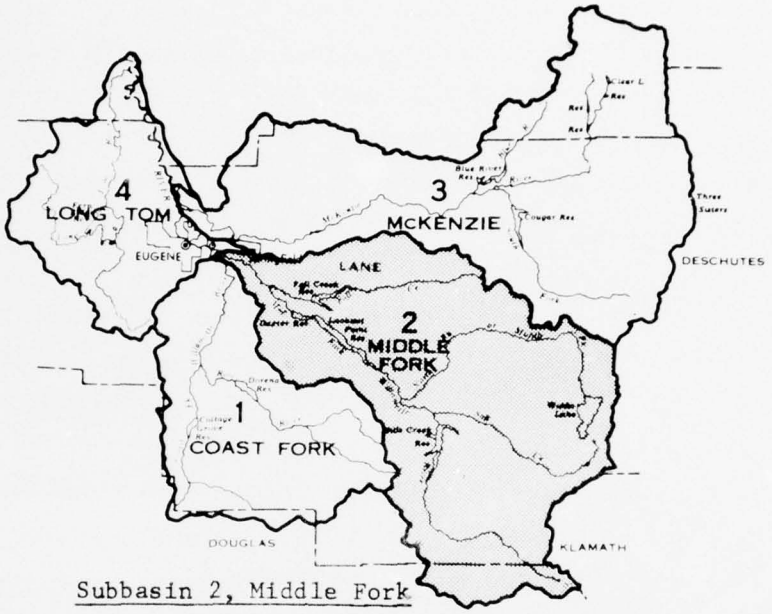
(3) Watershed projects having the best potential for meeting needs after 1980 are Goshen, Gettings Creek, Silk Creek, Morten Creek, Mosby Creek, and upper Coast Fork Willamette. Current land use, development, and water-related problems are shown in Table A-1 of Addendum A to Appendix G. Principal structural measures involved in those projects would be a 7,900-acre-foot reservoir, at site No. 23 on Silk Creek and about 20 miles of tributary channel improvements.

(4) Other features in the long-range category are: (a) additional irrigation facilities; (b) water-treatment facilities for municipal and industrial supplies; (c) additional recreation facilities at existing projects and on subbasin streams; (d) expansion of the Camas Swale Game Management Area by about 2,000 acres, and provision of a water supply, probably from upstream Federal reservoirs; and (e) additional channel improvement, on the Coast Fork and on tributary streams.

c. Alternatives and opportunities. - Storage also could be developed at site No. 6, on Coast Fork Willamette River upstream from Cottage Grove Dam. Early-action development could not be justified, but remaining needs would warrant inclusion as a long-range plan element. However, the Recreation Committee recommends that all but the existing reservoir portion of the Coast Fork be retained in its natural state. That action would help to meet recreational and environmental needs which could not be served, and might be aggravated, by development. Thus, the potential project was set aside as an alternative to environmental management.

d. Remaining needs. - As shown in Table IV-4, the projects discussed in preceding paragraphs would provide, so far as the subbasin alone is concerned, an apparent surplus of capability to provide service in some functional fields. For example, the additional storage needed to control a 100-year flood is in the order of 98,500 acre-feet, effective at Goshen; the plan would provide about 130,000 acre-feet, of which 112,000 would be effective. However, basin-system storage analyses show a considerable shortage of flood control space in the overall comprehensive plan, so far as control of a 100-year flood at Willamette Falls is concerned. Tables V-6 through 14 summarize, for each function and generally by subbasins, the remaining needs and additional capacities for service in excess of projected total basin needs.

SUBBASIN 2 - MIDDLE FORK



Subbasin 2, Middle Fork

The Setting

Subbasin 2 consists of the drainage area of Middle Fork Willamette River, which is about 11 percent of the total basin study area. Heading at the crest of the Cascade Range, it produces more than 12 percent of the total runoff from the Willamette River drainage. Three existing major multiple-purpose reservoirs, Hills Creek, Lookout Point, and Fall Creek, control runoff from about 87 percent of the subbasin area. Waldo Lake, the largest in the basin, is located in the headwaters. Only about two percent of subbasin lands are devoted to agriculture. The remainder are principally forested, and largely under Federal administration. The present population is about 10,000. Population density is less than one-tenth of the basin average, the lowest for any subbasin in the study area. The vast timber resources have been the principal base for the subbasin economy. Future economic growth is expected to be based principally on service industries, recreation and tourism.

Existing storage facilities are authorized for flood control; navigation; irrigation; and, except for Fall Creek, power generation. When operated under the existing authorizations, Hills Creek and Lookout Point

can provide minimum fish flows on the Middle Fork through 2020 with only minor shortages. Satisfaction of optimum requirements after 1980 would require additional storage. Fall Creek Reservoir presently is drawn down early in the year to meet downstream navigation needs. Under those conditions, it can only provide near-minimum flows during the latter part of the low-water season. Water temperatures in the Middle Fork downstream from Dexter Dam are favorable and no proposals have been made for temperature reduction. The Lookout Point Reservoir project blocks fish passage, and a holding pond, egg-taking facilities, and hatchery facilities have been provided. Proposals to trap and haul adult anadromous fish around that dam to upstream spawning areas hinge on determining a feasible means of transporting downstream migrants around or through Hills Creek, Lookout Point, and Dexter Reregulating Reservoirs. Natural production of warm-water game fish is expected to keep pace with future demands; but accelerated fisherman-access programs will be needed to maintain a balance between demand and available supplies.

Specified wildlife needs are minor with only a recommendation for acquisition and development of lands at a "pigeon spring" to enhance bandtailed pigeon habitat.

Annual flooding occurs on only about 500 acres in the entire subbasin. Existing storage facilities are adequate to control a 100-year flood at Jasper. A total of about 11 miles of channel improvement is needed on the Middle Fork and Fall Creek to facilitate reservoir operation for flood control. In addition, about 5.5 miles of channel improvement is needed on minor tributaries in the subbasin.

Present irrigation development in Subbasin 2 is relatively small; only about 2,100 acres are irrigated. Even with the projected threefold increase in irrigation between 1965 and 2020, there are abundant water supplies available to meet the needs. Storage in existing Federal reservoirs, and ground water, can easily meet the projected irrigation requirements; however, small amounts of additional storage would be desirable to provide a supply for some locations.

Municipal and industrial water rights and supplies appear adequate to meet 2020 demands. The town of Lowell will need to supplement its municipal water supplies by 2020; existing Federal reservoirs provide an available source.

Present recreation facility capacity would satisfy only about one-third of the projected demand by 2020, but water-surface capacity would exceed demands by more than three times. Water-oriented recreation development should emphasize providing additional facilities and improving access to the facilities. Consideration must be given to Recreation Committee recommendations that the North Fork of Middle Fork Willamette be left in natural condition under an environmental management program.

Flows recommended for pollution control within the subbasin are negligible; however, serious needs exist downstream on Willamette River which will require at least the continuation of present releases from existing reservoirs.

Subbasin Rationale

There is little need, in the subbasin, for additional multiple-purpose storage. Neither does there appear to be a need for physical modification of the three existing multiple-purpose reservoirs. However, consideration should be given to operation to insure provision of flows for fish life. Also, additional recreation and irrigation facilities should be provided, and some watershed improvement work should be done on minor tributaries.

The following discussions show pertinent subbasin rationale and outlines proposed development features. Table IV-5 presents a data summary, in units used in subbasin analysis, of water-related needs and anticipated storage accomplishments in the subbasin as of 2020.

a. Early-action features. - Early-action features were selected principally on the basis of subbasin needs. Included are: (1) a small watershed project, (2) basin-system channel improvements associated with flood-control operation of storage, and (3) miscellaneous other items--irrigation and recreation facilities, wildlife habitat improvement, land measures, and environmental management programs. Also, reauthorization of existing major reservoirs to include recreation, fish and wildlife, and water quality improvement as project purposes would be appropriate.

(1) Rattlesnake Creek Watershed Project would be developed in the early-action period to provide for flood control and irrigation needs. Flood control works would consist of 3.5 miles of channel

Table IV-5

Projected water-related needs and storage accomplishments

Subbasin 2 - Middle Fork, 2020

Item	Storage Project Data 1/ Capacity, ac.-ft. Total	To be Assigned 2/	Full Pool Area, Acres	Functions to be Served Auth.	New	Subbasin Needs and Accomplishments: Fish Life Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs 3/	Warm-Water, No. of Fish, 1,000's	Flood Control ac.-ft.	sq. mi.	Diversions, ac.-ft. Irrigation	M&I Supply	Navigation Flow, cfs	Power Cap., kw	Recreation, 1,000 rec.-days Resource Capacity	Facilities	Water Quality Control, cfs
A. *Projected Subbasin Needs*	-	-	-	-	-	*1,038*	*2,116*	*57*	*868,000 4/*	*1,161*	*17,600*	*8,000*	*0 5/*	*N/A 6/*	*8,000 7/*	*8,000*	*0 7/*
B. *Presently Assured Accomplishments:*	*864,800*	-	*10,000*	-	-	*350*	*738*	*9*	*590,000 4/*	*1,178*	*15,800*	*8,000*	*N/A 5/*	*165,000*	*10,993 8/*	*7,644*	*-10/*
1. Natural flow and small storage	N/A	-	N/A	-	-	N/A	N/A	9	-	-	4,100)		-	-)		-	-
2. Storage reservoirs:											)			)			
Lookout Point (incl. Dexter	483,500	-	5,385	FC,N,I,P	WS,R,F&W,WQ	N/A	N/A	-	337,000	991)	)		-	135,000)	10,993	845	-
Hills Cr. Rereg.)	356,000	-	2,735	FC,N,I,P	WS,R,F&W,WQ	N/A	N/A	-	200,000	-)	6,400)	8,000	-	30,000)		270	-
Fall Cr.	125,000	-	1,880	FC,N,I	WS,R,F&W,WQ	N/A	N/A	-	115,000	184)	)		-	0)		530	-
3. Groundwater	-	-	-	-	-	0	0	-	-	-	5,300)		-	-)	-	-	-
C. *Total Residual Needs*	-	-	-	-	-	*688*	*1,388*	*18*	*(+22,000) 4/*	*0*	*1,800*	*0*	*0*	*N/A 6/*	*(+7,993)*	*1,488*	*0*
D. *New Storage Accomplishments:*	*28,800*	-	*420*	-	-	-	-	-	*6,400 4/*	*26*	*1,800*	-	-	-	-	-	-
1. Early-action reservoirs - none	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Long-range reservoirs																	
Rattlesnake Cr. site No. 772	2,400	-	60	-	FC,I,O 9/	-	-	-	500	2	1,800	-	-	-	-	-	-
Little Fall Cr. site No. 37	20,400	-	360	-	FC,O 9/	-	-	-	7,700	24	-	-	-	-	-	-	-
E. *Year 2020 Conditions:*																	
1. *Subbasin storage totals*	*887,800*	-	*10,480*	-	-	-	-	-	-	-	-	-	-	*165,000*	-	-	-
2. Unmet needs	-	-	-	-	-	*688 10/*	*N/A 10/*	*18 10/*	*0*	*0*	*0*	*0*	-	*N/A 6/*	*0*	*1,488 11/*	-
3. Additional capacity	-	-	-	-	-	-	-	-	*28,400*	-	-	-	-	*0*	*7,993*	-	-

N/A Not available for subbasin or location.

1/ Additional data are shown in Part V.
2/ Additional study to be made; see Part V.
3/ At Jasper.
4/ Amount, effective at Jasper, for control of a 100-year flood.
5/ No need in subbasin; storage releases contribute to meeting Willamette River needs.
6/ Projections only on a total-basin basis.
7/ Includes Willamette River.
8/ Requirement met by natural flows.
9/ Space not fully assigned; some available for other purposes.
10/ Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.
11/ Can be met by implementation of programs presented in Appendix K, Recreation.

improvement and diversion of flood flows to Middle Fork Willamette River upstream from the major flood plain along Rattlesnake Creek. Irrigation works would consist of channels, canals, and pipelines for irrigation of about 800 acres along Rattlesnake Creek. Channel and canal development would be coordinated with fish and wildlife agencies.

(2) Basin-system channel improvement required as an adjunct to reservoir operation for flood control would include both channel stabilization and closure of overflow channels on the right bank of Middle Fork Willamette River. Operating experience has shown that both unstable channels and the overflow channels pose problems during evacuation of stored water following floods.

(3) Other features would include: (a) acquisition and development of lands at a mineral spring, to improve habitat for band-tailed pigeons; (b) provision, by the private sector with possible Federal program assistance, of irrigation facilities beyond those in the small watershed project; (c) additional high-density and general recreation facilities at existing reservoirs, natural lakes, and along Middle Fork Willamette River; (d) a local program of flood plain use regulation to complement the flood control effects of multiple-purpose storage; (e) the proposed environmental management program for Middle Fork Willamette River and the North Fork of Middle Fork Willamette River; (f) installation of five small group enterprise jobs on agricultural lands, involving channel improvements and improved drainage outlets; and (g) soil and water restoration measures, at 14 identified locations on O&C forest lands and at 44 locations on National forest lands.

b. Long-range features. - Even beyond the early-action period there appears to be little need, in the subbasin, for additional storage development. The principal subbasin needs to be considered are those for additional flood control, at watershed level and remaining downstream, and for additional irrigation development and recreation facilities.

(1) Watershed projects having the best potential for meeting needs after 1980 are Lost Creek and Little Fall Creek. Current status of land use, development, and water-related problems for each of those watersheds are shown in Table A-1, Addendum A to Appendix G. Principal structural measures involved in those projects would be a 20,400-acre-foot reservoir at site No. 37 on Little Fall Creek and about 2 miles of

tributary channel improvement. Also, a 2,400-acre-foot reservoir at site No. 572 in the proposed early-action Rattlesnake Creek Watershed Project area would be available for meeting needs after 1980.

(2) Flood control works for development after 1985 include about 6.5 miles of additional channel stabilization anticipated to be required on Middle Fork Willamette and 1 mile on Fall Creek. The channel stabilization would be in addition to the basin-system channel improvement to be done in the early-action period.

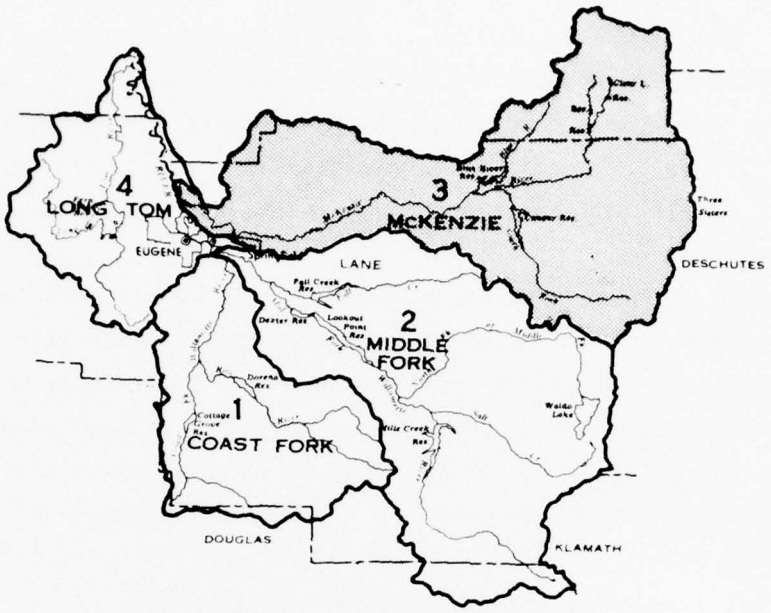
(3) Recreation facilities would be required, at existing reservoirs, natural lakes, and streams, to accommodate a considerable increase in use between 1980 and 2020.

(4) Irrigation facilities should be developed for about 4,000 additional acres. About one-half would be on an individual basis and one-half through group effort, financed privately or under Federal programs.

c. Alternatives and opportunities. - The principal opportunities for future development consist of: (1) a potential multiple-purpose project, at Upper North Fork site No. 55 on the North Fork of Middle Fork Willamette River, and (2) a potential single-purpose power project and seven identified potential pumped-storage power generation developments identified in Appendix J. The Upper North Fork site was set aside as an alternative less favorable than the proposed environmental management program. The single-purpose power site and the seven pumped-storage sites also were set aside. Most of those projects would be alternatives less favorable than proposed management, and development would be in conflict with Oregon State Water Resources Board beneficial use classifications. The single-purpose development would entail drawdown of Waldo Lake, which is being developed by USFS for recreational use. Also, basin-wide consideration of the overall pumped-storage proposal revealed that most of the total 26-million-kilowatt installation apparently needed by 2020 could be developed at sites with less-apparent environmental problems.

d. Remaining needs. - So far as the subbasin is concerned, Table IV-5 illustrates that development needs remaining as of 2020 would be small. Any additional development apparently would have to be justified by service which could be provided to downstream or out-of-subbasin needs. Tables V-6 through 14 summarize, by functions and for the basin as a whole, the remaining needs and additional capacities for water-related service in excess of projected basin needs.

SUBBASIN 3 - MCKENZIE



Subbasin 3, McKenzie

The Setting

McKenzie Subbasin consists of the McKenzie River watershed, located in the northeastern portion of the Upper Subarea. It contains 1,342 square miles, or 11 percent of the basin study area. About 70 percent of the subbasin is forested. Only four percent is in agricultural use; the remainder is in urban developments, roads, reservoirs, alpine areas, and lava flows in the headwaters area. Almost 70 percent of the subbasin lands are Federally administered. Access along the length of the stream is provided by U. S. Highway 126, which connects the Eugene-Springfield area to eastern Oregon. An excellent network of trails provides access to recreation lands in the back country. These include the Three Sisters and Mt. Washington Wildernesses and the associated lava, snow, and ice fields.

Average annual runoff is more than 3.9 million acre-feet, equivalent to an average annual discharge of about 5,400 cfs, or about 16 percent of Willamette River runoff. The stream has a generally well-sustained flow during the low-water season, particularly from the

natural ground water storage in the High Cascades lava flow area northeast of McKenzie Bridge. Ground water supply is generally good in the agricultural areas.

Population was 21,500 in 1960, and is projected to more than triple by 2020. Most of the people are concentrated in and adjacent to the Eugene-Springfield metropolitan area. Overall, present and projected population density per square mile is about one-fifth of the basin average. Timber harvesting and processing, and recreation, tourism, and light industry, respectively, now are the most important and fastest growing activities.

Existing and authorized development in the subbasin includes three multiple-purpose storage reservoirs, a municipally owned water and electric power system, considerable recreation lands and facilities, one small watershed project, and some development under land and watershed programs. The three Federal multiple-purpose projects in the subbasin are authorized to be operated for flood control, irrigation, and navigation. These are the existing Cougar and Blue River Reservoirs, at which recreation development has been provided, and Gate Creek Reservoir which is in the preconstruction planning stage. In addition, Cougar and the authorized Strube Reregulating Reservoir associated with it are authorized to be operated for power generation. The principal non-Federal elements are the reservoirs, power-generating installations, and the water supply system of the Eugene Water and Electric Board.

The stream is particularly clean, clear, cold, and attractive, with a considerable resident and anadromous fish population. A State Water Resources Board program establishes recreation and fish life as the principal beneficial uses of the waters of much of the upper subbasin and tends to preclude developments for other uses. To that extent, the scenic and esthetic resources of the subbasin now are protected. However, the State's program can be modified upon a showing of overall need, and exceptions were made for the existing Eugene Water and Electric Board projects.

The Recreation Committee has recommended that certain streams be maintained in natural condition, under an environmental management program. The streams involved are McKenzie River; South Fork McKenzie River; White Branch, Horse, and French Pete Creeks; and all streams in the Mt. Washington and Three Sisters Wildernesses. There are sites

available on some of those streams for possible multiple-purpose and single-purpose projects, and for development of pumped-storage power generation. The value of those development potentials will have to be weighed against the value of the fish, wildlife, and environmental resources which would be affected by project development.

Anadromous fish needs are for provision of increased flows of good quality water, and for passage around man-made and natural migration barriers. No water temperature problems are obvious, although there are indications of project-caused low temperatures or other factors which interrupt upstream migration of adult fish.

Optimum and minimum fishery flows, as shown by Appendix D, cannot be provided by presently scheduled operation of existing and authorized storage. Wildlife needs, as in most of the other subbasins, are for additional and improved habitat and hunter access.

Flood control needs of the subbasin are relatively small, except along the lower reaches where high-value agricultural lands and encroaching urban developments are subject to damage. Existing development, however, provides less than one-half of the effective storage needed to control a 100-year flood at Coburg. As a consequence, an annual average of roughly 1,100 acres are inundated by floods. Resulting average annual damages amount to about $350,000, and are projected to nearly double by year 2020 if no additional measures are taken. McKenzie River floods contribute substantially to damage along all of Willamette River downstream.

Lane County has adopted zoning ordinances which regulate the use of the flood plains. The areas involved in this subbasin extend from the mouth of McKenzie River upstream about 50 miles and from the mouth of Mohawk River upstream along that stream about 12 miles. Flood plain zoning, if maintained until 2020, would limit the increase in average annual damages to about $200,000.

Local works, needed to supplement substantially any degree of storage control, would consist of channel improvement. The principal needs are to stabilize the confluence of McKenzie and Willamette

Rivers and about 19,000 feet of channels, and provide and maintain channel capacity adequate to confine flood control storage evacuation flows to the channel.

Irrigation in the subbasin presently relies on natural flow, farm ponds, and ground water as sources of supply to irrigate about 7,800 acres. Projections indicate that irrigated lands will increase to about 12,000 acres by 2000, and then decline to about 10,000 acres in 2020 as agricultural lands are converted to urban use.

Most of the irrigable lands in the subbasin are close to available water supplies from streams, small ponds, and ground water. Those lands probably will be irrigated on an individual basis. There is an area in Mohawk River Valley where about 1,000 acres could be developed on a project basis if storage could be justified on that stream.

The municipal and industrial water supply needs which must be considered include those of the small communities within the subbasin and those of the Eugene-Springfield service area, most of which is located outside of the subbasin. The smaller communities are expected to expand the use of the present ground water and natural flow sources and should have no serious problems in meeting their projected needs.

Most of the municipal and about two-thirds of the industrial water supply for the Eugene-Springfield service area is obtained from McKenzie River. The remainder comes from wells. Those sources, which are expected to continue to be used, appear adequate through 2020. Existing water rights also appear adequate. Therefore, it appears that no new storage will be required for municipal and industrial purposes. However, full use of existing rights to natural flow would tend to deplete low-water flows and thus degrade fish-life habitat in the lower reaches of the McKenzie.

Recreational capacity of water surface areas in and immediately adjacent to the subbasin is more than adequate to meet projected 2020 needs. Nonetheless, locational deficiencies may make a small amount of additional water surface area desirable, particularly in the day-use zone of the Eugene-Springfield area. Existing recreation facilities will be adequate to meet the demands until after 2000, but between 2000 and 2020 facilities must be constructed to provide for nearly 1 million additional recreation days of use.

Other recreation-oriented needs which should be considered for early action include: (1) improved access to, and protection of, unique wilderness, botanical, geological, and scenic areas; (2) additional scenic and general access roads and trails; (3) additional boat access to McKenzie River; and (4) a review of historical features to permit establishment of an interpretive program.

Projections of power needs in the basin and region indicate that any additional generating capacity which might be developed at a justifiable cost would be utilized.

Water pollution control needs are principally those for adequate treatment of waste loading as it develops. Present quality of flows is relatively good in the lower reaches and pollution is almost nonexistent upstream from the pulp mill near river mile 10.7. Present flows and minimum flows under State Water Resources Board programs are considerably in excess of those required to maintain satisfactory quality. Thus, subbasin needs do not warrant additional flow augmentation by storage. Downstream needs, however, are such that any increment of good quality flow would be of value.

Subbasin Rationale

McKenzie Subbasin has a wide range of recreational opportunities and natural environmental assets. Streams are clear, clean, and cold, and offer white water, scenery, and nationally known trout fishing. In the headwaters are vistas of superlative mountain scenery, unusual lava fields and geologic formations, permanent snow and ice fields, more than a hundred lakes, and two designated wildernesses. In total, the McKenzie and its subbasin provide perhaps the most scenic and overall desirable natural environment in the total study area.

Functional needs of the subbasin for additional storage development are small, except for flood control. The degree of storage control in the subbasin, in terms of area from which runoff is controlled, is relatively very low. At the same time, the excellence of its recreational and overall natural environment is almost unparalleled in the basin as a whole and has been recognized in OSWRB programs and Recreation Committee recommendations.

On the basis of all those considerations, development proposals are limited to programs and projects generally compatible with the concept of preservation of natural environment.

The following discussions show pertinent subbasin rationale and outline proposed features. Table IV-6 presents summary data of water related needs and anticipated accomplishments in the subbasin as of 2020, in units as used in subbasin analysis.

a. Early-action features. - No storage or watershed projects are proposed for early action in McKenzie Subbasin; however, one watershed project would divert water from McKenzie River near river mile 7. That project would be located mostly in Subbasin 5, and is included in that subbasin discussion. Other features would consist of basin-system channel improvement, private-sector irrigation development, environmental management, and development of nonwater-related recreational measures.

(1) Basin-system channel improvement, to permit efficient flood control operation of existing and authorized storage would include channel stabilization and overflow channel closures. Experience with operation of Cougar Reservoir has shown that certain reaches of the lower river are unstable and that, as a consequence, channel capacity adequate for reservoir evacuation is not dependably available. Also, there are several overflow channels in the lower reaches through which evacuation flows reach and do damage to adjoining lands and improvements.

(2) Irrigation development in the early-action period is expected to be by the private sector, based primarily on use of ground water.

(3) Other features would consist primarily of programs for: (a) environmental management of McKenzie and South Fork McKenzie Rivers, except for existing development and basin-system channel improvements; White Branch, Horse, and French Pete Creeks; and all streams in the two wildernesses; (b) local flood plain use regulation; (c) fish and wildlife programs with emphasis on angler and hunter access; (d) installation of two small group enterprise jobs on agricultural land, involving channel improvement; and (e) soil and water restoration measures at 16 identified locations on O&C forest lands and 38 locations in National forests.

Table IV-6
Projected water-related needs and storage accomplishments
Subbasin 8 - McKenzie, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments											
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life					Diversions, ac.-ft.		Navigation Flow, cfs	Power Capacity, kw	Recreation, 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs 3/	Warm-Water, No. of Fish, 1,000's	Flood Control ac.-ft.	Flood Control sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. *Projected Subbasin Needs*	-	-	-	-	-	*1,034*	*2,000*	*8*	*600,000 4/*	*1,070*	*94,200*	*330,000 6/*	*0 6/*	*N/A 7/*	*1,860*	*2,680*	*140-270 8/*
B. *Presently Assured Accomplishments:*	*388,900*	-	*3,090*	-	-	*850*	*1,817*	*3*	*248,000 4/*	*340*	*58,300*	*226,000*	*N/A 6/*	*170,000 8/*	*4,179 9/*	*260*	*10/*
1. Natural flow and small storage	N/A	-	N/A	-	-	N/A	N/A	3	-		10,200)		-	111,500)		-	-
2. Storage reservoirs:											)			)			
Gate Cr. (auth.)	55,000	-	605	FC,N,I	R,F&W,WQ	N/A	N/A	-	50,000	50	-)	226,000	-	0)	3,179	65	-
Blue R.	89,000	-	975	FC,N,I	R,F&W,WQ	N/A	N/A	-	85,000	88	-)		-	0)		75	-
Cougar (incl. auth. Strube Rereg.)	224,900	-	1,510	FC,N,I,P	R,F&W,WQ	N/A	N/A	-	155,000	208	-)		-	64,500)		220	-
											)						
3. Groundwater	-	-	-	-	-	-	-	-	-	-	12,100)		-	-	-	-	-
C. *Total Residual Needs*	-	-	-	-	-	*684*	*688*	*8*	*886,000 4/*	*784*	*5,800*	*0*	*0*	*N/A 7/*	*(+1,858)*	*3,940*	*0*
D. *Net Storage Accomplishments:*	*27,500*	-	*880*	-	-	-	-	-	*6,700 4/*	*88*	*5,800*	-	-	-	-	-	-
1. Early-action reservoirs - none	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Long-range reservoirs:																	
Shotgun Cr. site No. 116	12,700	-	275	-	FC,I,O 11/	-	-	-	4,500	15)	2,600	-	-	-	-	-	-
Upper Mohawk #2, site No. 121	24,500	-	275	-	FC,I,O 11/	-	-	-	5,800	18)		-	-	-	-	-	-
E. *Year 2020 Conditions:*																	
1. *Subbasin storage totals*	*406,100*	-	*3,840*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. *Unmet needs*	-	-	-	-	-	*684 12/*	*688 12/*	*8 12/*	*344,700 4/*	*681*	*0*	*0*	-	*N/A 7/*	*0*	*1,940 13/*	-
3. *Additional capacity*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*3,860*	-	-

N/A Not available for subbasin or location.

Additional data are shown in Part V.
Additional study to be made; see Part V.
At Coburg.
Amount, alternative at Coburg, for control of a 100-year flood.
Includes all but the Junction City and Elmira-Veneta portions of the total requirement for the Eugene-Springfield service area.
To meet in subbasin, storage releases contribute to meeting Willamette River needs.
Requirements only on a total-basin basis.
Including woods/pasture development.
Willamette River.
Requirement met by natural flows.
Some will likely developed, some available for other purposes.
Can be met by implementation of stream and management programs discussed in Appendix E, Fish and Wildlife.
Can be met by the construction of programs presented in Appendix K, Recreation.

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THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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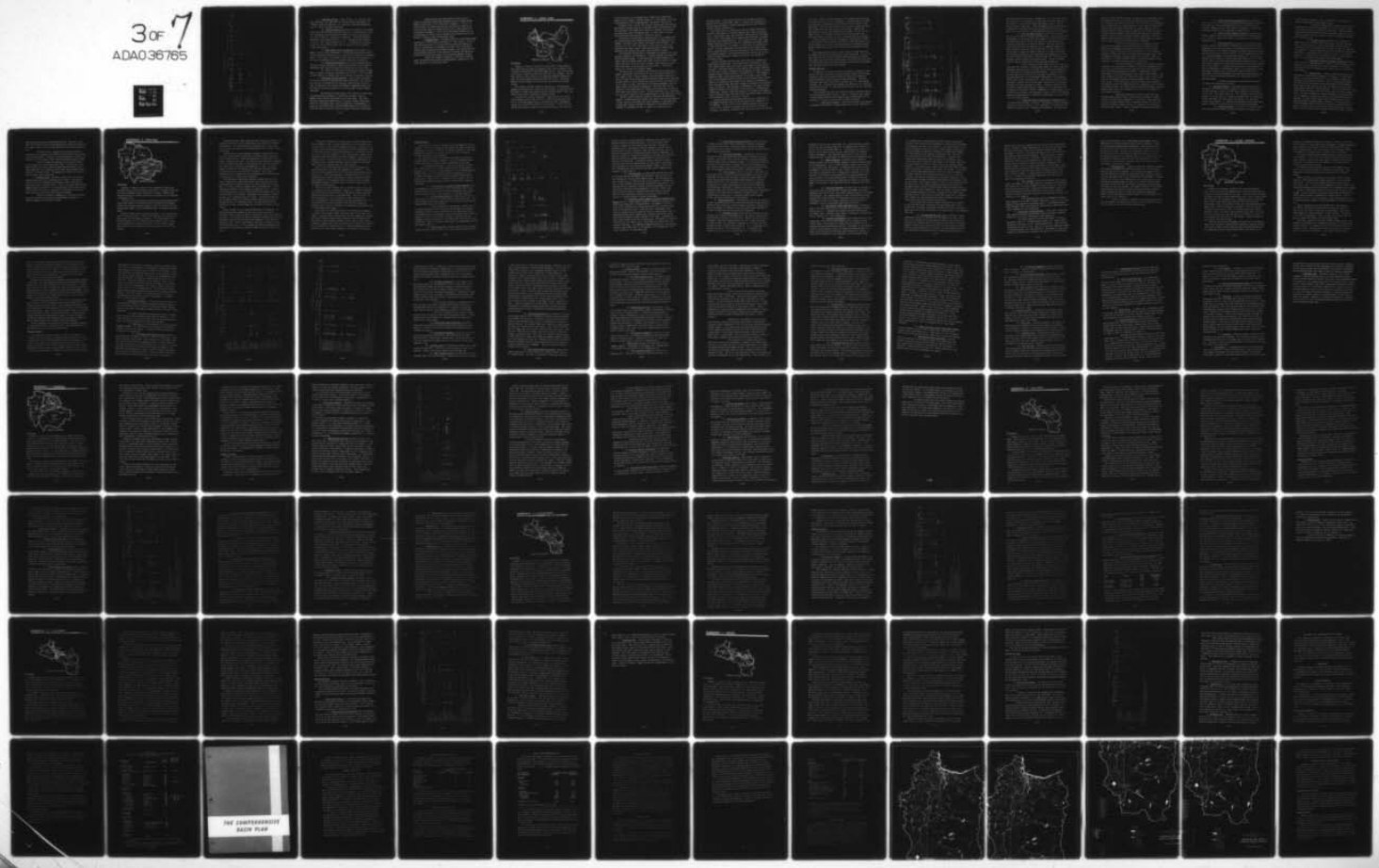


Table IV-6
Projected water-related needs and storage accomplishments
Subbasin 3 - McKenzie, 2020

Item	Storage Project Data 1/ Capacity, ac.-ft. Total	To be Assigned 2/	Full Pool Area, acres	Functions to be Served Auth.	New	Subbasin Needs and Accomplishments: Fish Life Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs 3/	Warm-Water, No. of Fish, 1,000's	Flood Control ac.-ft.	sq. mi.	Diversions, ac.-ft. Irrigation	M&I Supply	Navigation Flow, cfs	Power Capacity, kw	Recreation, 1,000 rec-days Resource Capacity	Facilities	Water Quality Control, cfs
A. *Projected Subbasin Needs*	-	-	-	-	-	*1,034*	*2,000*	*8*	*600,000 4/*	*1,070*	*24,000*	*220,000 5/*	*0 6/*	*N/A 7/*	*1,660*	*1,660*	*140-270 8/*
B. *Presently Assured Accomplishments:*	*368,900*	-	*3,090*	-	-	*380*	*1,317*	*3*	*248,000 4/*	*846*	*22,800*	*220,900*	*N/A 6/*	*170,000 9/*	*2,178 9/*	*860*	*10/*
1. Natural flow and small storage	N/A	-	N/A	-	-	N/A	N/A	3	-		10,200)		-	111,500)		-	-
2. Storage reservoirs:											)			)			
Gate Cr. (auth.)	55,000	-	605	FC,N,I	R,F&W,WQ	N/A	N/A	-	50,000	50	-)	226,000	-	0)	3,179	65	-
Blue R.	89,000	-	975	FC,N,I	R,F&W,WQ	N/A	N/A	-	85,000	88	-)		-	0)		75	-
Cougar (incl. auth. Strube Rereg.)	224,900	-	1,510	FC,N,I,P	R,F&W,WQ	N/A	N/A	-	155,000	208	-)		-	64,500)		220	-
											)						
3. Groundwater	-	-	-	-	-	-	-	-	-	-	12,100)		-	-	-	-	-
C. *Total Residual Needs*	-	-	-	-	-	*684*	*688*	*5*	*388,000 4/*	*724*	*8,400*	*0*	*0*	*N/A 7/*	*(+1,518)*	*1,500*	*0*
D. *New Storage Accomplishments:*	*37,200*	-	*880*	-	-	-	-	-	*6,700 4/*	*38*	*2,600*	-	-	-	-	-	-
1. Early-action reservoirs - none	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Long-range reservoirs:																	
Shotgun Cr. site No. 116	12,700	-	275	-	FC,I,O 11/	-	-	-	4,500	15)	2,600	-	-	-	-	-	-
Upper Mohawk #2, site No. 121	24,500	-	275	-	FC,I,O 11/	-	-	-	5,800	18)		-	-	-	-	-	-
E. *Year 2020 Conditions:*																	
1. *Subbasin storage totals*	*406,100*	-	*3,840*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. *Unmet needs*	-	-	-	-	-	*684 12/*	*688 12/*	*5 12/*	*344,700 4/*	*681*	*0*	*0*	-	*N/A 7/*	*0*	*1,320 13/*	-
3. *Additional capacity*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*1,658*	-	-

N/A *Not available for subbasin or location.*

1/ *Additional data are shown in Part V.*
2/ *Additional study to be made; see Part V.*
3/ *At Coburg.*
4/ *Amount, effective at Coburg, for control of a 100-year flood.*
5/ *Includes all but the Junction City and Elmira-Veneta portions of the total requirement for the Eugene-Springfield service area.*
6/ *No need in subbasin; storage releases contribute to meeting Willamette River needs.*
7/ *Projections only on a total-basin basis.*
8/ *Excluding non-hydropower developments.*
9/ *Includes Willamette River.*
10/ *Requirement met by natural flows.*
11/ *Space not fully assigned; some available for other purposes.*
12/ *Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.*
13/ *Can be met by implementation of programs presented in Appendix K, Recreation.*

b. Long-range features. - These include: (1) two small watershed reservoirs, (2) additional basin-system channel improvement, (3) tributary channel improvements, (4) additional recreation development, and (5) limited irrigation development.

(1) Watershed projects having the best potential for meeting needs after 1980 are Camp Creek and Mohawk River. Current status of land use, development, and water-related problems for each of those projects are shown in Table A-1, Addendum A to Appendix G. Principal structural measures in those projects would be: (a) a 24,500-acre-foot reservoir at site No. 121 on upper Mohawk River, (b) a 12,700-acre-foot reservoir at site No. 116 on Shotgun Creek, and (c) about 16 miles of tributary channel improvements.

(2) Basin-system channel improvements would consist of expansion of early-action development to include additional channel stabilization, including stabilization of the confluence of McKenzie and Willamette Rivers. Total extent of development needed will have to be evaluated on the basis of experience with all authorized reservoirs in operation.

(3) Recreation development would include additional installations at existing and presently authorized reservoirs, plus cooperative development under recreation programs on streams and at natural lakes.

(4) Except for those lands associated with storage on Mohawk River, irrigation facilities requirements will be minor. After year 2000, the total amount of irrigated land in the subbasin is expected to decline.

c. Alternatives and opportunities. - These consist principally of sites for storage and single-purpose power development. Such development would not be compatible with presently defined concepts and objectives, as embodied in the proposed environmental management program, but the sites have physical potential for future use under possible changed conditions.

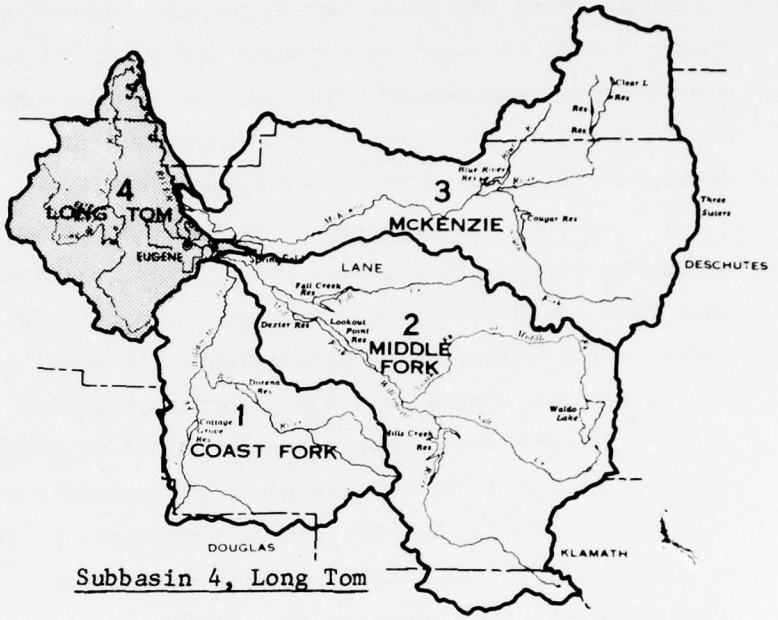
The principal multiple-purpose sites involved, in downstream-to-upstream order, are Thurston, Foley Ridge, and Twisty Creek on McKenzie River, and the Horse Creek site on that stream. Foley Ridge and Twisty Creek offer possibilities for mutually exclusive development; either one, with Horse Creek, could be alternative or supplemental to a project at the Thurston site. Existing OSWRB beneficial-use classification would have to be modified before the upper sites could be developed.

Single-purpose power opportunities include sites for potential conventional generating installation and for pumped-storage peaking installations, all as identified in Appendix J. All are in locations where the OSWRB beneficial-use classification makes no provision for major power development and many are in areas proposed for environmental management. All but two of the pumped-storage sites are in wildernesses or Forest Service dedicated areas, and none are in the Appendix J listing of nine most-favorable sites.

d. Remaining needs. - As shown in Table IV-6, development needs remaining as of 2020 would be principally for flood control. A part of that need would be met by the flood plain use regulation program and there is a possibility of developing a few small local flood control projects under available small-projects programs. Any significant storage development would have to be justified by subbasin and downstream needs which would warrant change in the proposed management program.

Tables V-6 through 14 summarize, by functions, projected needs and identified water-related accomplishments, generally for subbasin elements, for the plan as a whole.

SUBBASIN 4 - LONG TOM



Subbasin 4, Long Tom

The Setting

Subbasin 4, Long Tom, consists of the watershed of Long Tom River plus lands along both banks of Willamette River from the subbasin 2 and 3 boundaries downstream to the mouth of the Long Tom. Less than one-half of the area is forested and more than one-third is in farmland. The subbasin includes a major portion of the Eugene-Springfield metropolitan area, the second-largest population center in the basin. Population density is second highest in the basin and more than twice the basin average.

The subbasin's economy is based on agriculture, food-processing, logging, and manufacture of lumber and wood products. In addition to the University of Oregon, the metropolitan area contains Federal, State, and County offices, which contribute to subbasin income.

Long Tom River, and its tributaries, constitute the only totally-within-subbasin surface water resource. It has an average annual run-off, at the Monroe gaging station, of 565,000 acre-feet. Substantial control is effected by Fern Ridge Dam and Reservoir. Stream flows are low and warm during the summer, and less than one-half of the 700 miles

of water courses carry continuous flows. Summer water temperatures, except in the Willamette, commonly exceed 75°F.; temperature in the Long Tom downstream from Fern Ridge Reservoir has reached a high of 84°F.

Willamette River, with natural flows and stored water from existing and potential storage projects, is available along the northeastern part of the subbasin. The ground water resource is adequate for increased use along both sides of Willamette River. In other areas of the subbasin, the ground water potential is relatively limited.

The principal existing water resource projects in the subbasin are the multiple-purpose Fern Ridge Dam and Reservoir (including Long Tom channel), the Amazon Creek channel, and several bank revetments. Other projects which are either constructed or under construction include the Amazon-Flat Creek, Spencer Creek, Central District, Hulbert Lake, and River Road projects, and a part of the Willakenzie Project.

Fern Ridge Dam and Reservoir is authorized to be operated for flood control, irrigation, and navigation. Irrigation demands have been small, but are growing rapidly. To the extent that irrigation demands will permit, and on an interim basis, the current operation plan is to retain stored water until about the first of October, when initiation of drawdown is necessary to provide space for flood control. This interim measure is to provide for recreation usage.

Anadromous fish are stocked in the system by the Fish Commission of Oregon. Optimum fish flow would be 50 cfs at USGS Gage 14-1690 and 42 cfs at gage 14-1700. Native cutthroat trout have adapted themselves to survive in some stream reaches despite unfavorable summer water conditions. Projected needs for trout fishing can be met by habitat improvements such as sill logs in streams, construction of fishing impoundments, improved angler access, and artificial propagation. Warm-water game fish are plentiful in Fern Ridge Reservoir, Long Tom River downstream, and several oxbow lakes along Willamette River. Improved fisherman access constitutes the only action required to meet projected needs for warm-water game fishing.

Specific wildlife needs are related to waterfowl and band-tailed pigeons. Increased waterfowl habitat would result from the stabilization of water levels at Fern Ridge, and water management on adjoining lands. Although this program, discussed in Appendix D, would depend on procurement of replacement storage, it appears to be consistent with

recreation needs. Seven mineral springs in the subbasin are used by pigeons and are popular hunting areas. Acquisition and development of these springs are needed to improve pigeon populations and facilitate control of hunter distribution.

Fern Ridge Reservoir, including the Long Tom channel improvement, provides a high degree of protection against major floods in Long Tom River. Uncontrolled runoff from tributaries downstream from Fern Ridge, however, still causes damage in the subbasin and contributes to damages downstream along Willamette River. Also, Willamette River floods cause damages along the northeastern edge of the subbasin and increase stages in lower Long Tom River. An average of 11,800 acres are inundated annually. A further consideration is that evacuation of stored floodwaters causes problems of continued inundation of some low-lying areas; the existing channels of the Willamette and lower Long Tom are not adequate to contain evacuation releases plus natural flows during the evacuation period.

Long Tom Subbasin contains about 132,000 acres of irrigated and potentially irrigable land. The irrigated land is expected to reach about 63,000 acres by 2020 and require a water supply of about 158,300 acre-feet. Fern Ridge Reservoir, when operated under present authorization for flood control, irrigation, and navigation, can supply an annual average of about 55,000 acre-feet of irrigation water. That storage is committed, under existing authorizations, to an area of about 22,000 acres in the potential Long Tom Division of the Willamette River Project. Overall, the irrigation water supply in the subbasin is inadequate to meet future needs unless additional storage is developed or an additional supply is imported. That shortage is compounded by the rapidly growing demand for retention of stored water in Fern Ridge for recreation and related uses. However, additional supplies are available in Willamette River from natural flows, and water stored in upstream Federal reservoirs can be diverted to serve a portion of the area.

Specific municipal and industrial water needs are identified for the Eugene-Springfield service area and several other communities in the subbasin. So far as most of the Eugene-Springfield service area portion of the subbasin is concerned, sources outside the subbasin (McKenzie and possibly Willamette Rivers and ground water) will continue

to be used. Monroe's projected needs as of year 2020 exceed its surface water right by about 1.7 mgd. Consequently, it appears that new storage or ground water development will be called upon to meet Monroe's long-range needs. Harrisburg and Junction City are already relying upon wells and are expected to continue to do so in the future. However, the Veneta-Elmira community area probably could contract for water from the Eugene system, or for adequate storage in Fern Ridge or one of the potential upstream reservoirs, if future conditions make that advisable.

Present slackwater resources are adequate, through the year 2000, to meet project recreation needs, provided that Fern Ridge Reservoir can be maintained at full or near full levels during the recreation season. However, additional facilities will be required as deficiencies already exist.

Fern Ridge Reservoir inflow is minor during the summer months and the large, shallow reservoir has prolific algal production. In Long Tom River below the dam, natural turbidity, high temperatures, and noticeable algal blooms lessen its attractiveness. The waste load on the stream is minor and the flows required to assimilate that load are considerably less than flows required for other purposes.

Subbasin Rationale

In addition to the need to resolve the problem of irrigation, navigation, and flood control needs versus recreation demands on Fern Ridge Reservoir, there are substantial identified needs in the subbasin to justify additional multiple-purpose storage development. Principal functional needs which require active response are: (1) flood damage reduction, (2) irrigation water supplies and facilities, (3) additional recreation facilities, (4) improved wildlife habitat, and (5) watershed protection measures.

The following discussions show pertinent subbasin rationale and outline proposed development features. Table IV-7 presents a data summary of water-related needs and anticipated storage accomplishments in the subbasin as of 2020, in units as used in subbasin analysis.

a. Early-action features. - Early-action features were selected principally on the basis of subbasin needs, but also with consideration

Table IV-7
Projected water-related needs and storage accomplishments
Subbasin 4 - Long Tom, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments										
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Navigation Flow, cfs	Power Cap., kw	Recreation, 1,000 rec-days		Water Quality Control cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous Flow, cfs 3/	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. *Projected Subbasin Needs*	-	-	-	-	-	86	4/	340	142,000 5/	315	158,300	18,000 6/	0 7/	N/A 8/	3,249	3,249	4-6 3/
B. *Presently Assured Accomplishments:*	117,000	-	10,400	-	-	29	0	115	104,500 5/	275	191,600	18,000	N/A 7/	0	6,067 9/	2,700	10/
1. Natural flow and small storage	N/A	-	N/A	-	-	N/A	-	115	-		16,600		-	-)		-	-
2. Storage reservoirs:																	
Fern Ridge	117,000	-	10,400	FC,N,I	R,F&W,WQ,WS	N/A	-	-	110,000	275	126,600	18,000	-	0)	6,067	2,700	-
Upstream Willamette Reservoirs	11/	-	11/	-	-	-	-	-	-	-	-		-	-)		-	-
3. Groundwater	-	-	-	-	-	-	-	-	-	-	48,400		-	-	-	-	-
C. *Total Residual Needs*	-	-	-	-	-	57	0	225	38,500 5/	40	(+33,300)	0	0	N/A 8/	(+2,818)	549	0
D. *New Storage Accomplishments:*	112,200	-	4,180	-	-	82	-	-	N/A	9	14,100	-	-	-	1,705	1,580	-
1. Early-action reservoirs:																	
Bunker Hill, site No. 130	10,000)	2,200	410	-	FC,R	51 12/	-	-	2,500	-	-	-	-	-)	205	200	-
Unnamed, site No. 137	10,500)		320	-	FC,I,O 13/	-	-	-	2,100	-	6,100	-	-	-)		-	-
Bear Cr. site No. 129	2,500	-	110	-	FC,I	-	-	-	450	2	2,400	-	-	-)	52	-	-
Owens Cr. site No. 573	8,200	-	130	-	FC,I,R	16 12/	-	-	1,130	4		-	-	-)		52	-
Ferguson Cr. site No. 134	6,000	-	120	-	I,R	15 12/	-	-	-	-	5,600	-	-	-)	48	48	-
Unnamed, site No. 167	5,700	-	130	-	FC,I	-	-	-	830	3		-	-	-)	-	-	-
Fern Ridge Modification for Rec., Diversion from Willamette R.	-	-	-	-	R	-	-	-	-	-	-	-	-	-	1,400	1,280	-
Subtotals	42,900	-	1,220	-	-	82 12/	-	-	7,010	9	14,100	-	-	-	1,705	1,580	-
2. Long-range reservoirs:																	
Upper Noti, site No. 172	35,000	-	1,920	-	FC,I,R,F&W	N/A	-	-	30,000 14/	-	15/	-	-	-	-	-	-
Poodle Cr., site No. 157	14,300	-	320	-	FC,O 13/	N/A	-	-	2,200 14/	-	-	-	-	-	-	-	-
Log Pond, site No. 149	20,000	-	720	-	FC,O 13/	N/A	-	-	3,600 14/	-	-	-	-	-	-	-	-
Subtotals	69,300	-	2,960	-	-	-	-	-	35,800	-	-	-	-	-	-	-	-
E. *Year 2020 Conditions:*																	
1. *Subbasin storage totals*	229,200	-	14,580	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. *Unmet needs*	-	-	-	-	-	0	-	225 16/	N/A 17/	31	0	0	-	N/A 8/	0	0	-
3. *Additional capacity*	-	-	-	-	-	25 18/	-	-	N/A 17/	-	47,400 19/	-	-	-	4,823	1,031	-

N/A *Not available for subbasin or location.*

1/ *Additional data are shown in Part V.*
2/ *Additional study to be made; see Part V.*
3/ *At Monroe.*
4/ *No potential for anadromous fish shown in Appendix D.*
5/ *Amount, effective at Monroe, for control of a 100-year flood.*
6/ *Excludes all but the Junction City and Elmira-Veneta portions of the Eugene-Springfield service area. Eugene-Springfield needs are shown in text on Subbasin 3 - Mckenzie.*
7/ *No need in subbasin; storage releases contribute to meeting Willamette River needs.*
8/ *Projections only on a total-basin basis.*
9/ *Includes Willamette River.*
10/ *Requirement met by natural flows.*
11/ *Data shown in text on subbasins 1 and 2.*
12/ *Capacity based on 125 fish per surface acre; management practices discussed in Appendix D required for utilization of potential.*
13/ *Space not fully assigned; some available for other purposes.*
14/ *Effect limited by requirement for filling prior to initiation of filling at existing Fern Ridge reservoir.*
15/ *Project development would provide a part of the replacement supply needed to facilitate recreation at Fern Ridge.*
16/ *Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.*
17/ *Depends on use mix of long-range storage; additional study required.*
18/ *At present angler success ratio; additional fish would be used, to the extent available.*
19/ *For use in West Long Tom Division (subbasin 6).*

of possible downstream services. Included are: (1) three small watershed projects, (2) improvements to resolve the problem of water use at Fern Ridge, (3) basin-system channel improvement, and (4) private sector irrigation development. Other development would consist primarily of additional recreational facilities and improved wildlife habitat. Also, there is a possibility of nuclear-fueled thermal power development.

(1) Small watershed projects are those for the Coyote-Spencer, Bear Creek, and Ferguson Creek watersheds. Those projects would be developed, in cooperation with local sponsors, to improve the watershed environment and to satisfy local desires for flood protection, irrigation, recreation, and fish and wildlife. The three projects include six multiple-purpose reservoirs with an aggregate capacity of about 43,000 acre-feet and a total surface area of about 1,200 acres. In addition to storage and related facilities, the watershed projects would include provisions to meet associated land treatment needs, about 12 miles of channel improvement to meet the needs for flood control and drainage, and an irrigation distribution system. Channel improvement would be closely coordinated with fish and wildlife agencies.

Project facilities would protect about 2,300 acres of flood plain and provide an irrigation water supply for nearly 5,000 acres. Recreation facilities would be provided for an initial use estimated to be in the order of 150,000 visitor-days annually. Project reservoirs would provide about 23 percent and 12 percent, respectively, of the drainage-area-control and flood-storage requirements at the downstream Monroe control point on Long Tom River. Also included are about 2,200 acre-feet of capacity which could be used to satisfy about 63 percent of the summer low-flow requirement at Monroe. Particular attention would be given to possible development of storage for use in connection with recreation at Fern Ridge. Specific assignments, or sizing changes, would be made during preconstruction planning by project sponsors and concerned agencies in consideration of potentials for enhancement of fish and wildlife as a project purpose.

(2) Fern Ridge Project modification for recreation would be an early-action element of the plan. The problem is that of demand for recreation use versus failure to fill, evaporation, and authorized withdrawals for minimum flows, irrigation, and navigation. The total need

would be for about 120,000 acre-feet of additional, or replacement, supply. The available upstream sites in the early-action plan could provide no more than about one-tenth of that total. The Noti site, in the long-range plan, could provide up to about one-fourth. Thus, unless the navigation function (with its present requirement for about 24,000 acre-feet of storage) could be changed in scope or assigned to an alternative source, the total upstream storage in the subbasin plan would be from 65,000 to 80,000 acre-feet short of providing a complete replacement. However, a complete replacement supply probably would be neither needed nor justifiable, as some variation in pool level would be tolerable.

Diversion from Willamette River, possibly by local effort and using either or both natural flows and stored water from upstream sites depending on seasonal availability of natural flows, would be a logical first step to resolve the problem. Such diversion apparently could provide all of the justifiable replacement supply needed to supplement additional storage upstream from Fern Ridge. Also, the possibility of a revised filling schedule, to provide increased filling capability, should be evaluated as soon as practicable.

From the standpoint of timing to meet present recreation, irrigation, and other needs, the benefits of locally accomplished diversion could be realized earlier than could those from other alternatives, which would require Congressional approval. Implementation of the Coyote-Spencer project plan appears to be at least 5 years distant. Long-range storage at the Noti site would be more than 15 years in the future. A locally accomplished diversion, however, probably could be made in 2 years or less. That work probably could be planned to be an element of the proposed overall Fern Ridge modification. Depending on other possible water-rights filings, some stored water from upstream Willamette reservoirs probably would have to be contracted for to provide a full supply for any extensive diversion.

Operational modification to the existing Fern Ridge multiple-purpose storage project would include any changes to enhance filling, plus appropriate maintenance of a stable pool level consistent with (1) proposed reauthorization to include recreation and fish and wildlife as project purposes, and (2) the availability of alternative sources of water supply to offset withdrawals and evaporation depletion.

(3) Basin-system channel improvements along Willamette River, to facilitate flood control operation of existing major reservoirs, are needed now. Those improvements would include overflow closures, clearing, snagging, and some minor channel realignment, all associated with major reservoir projects operated for flood control.

(4) Private sector irrigation development is expected to provide irrigation facilities beyond those identified in watershed projects. Sources of supply will consist of farm ponds, existing storage, and ground water.

(5) Other features would include: (a) additional acquisition of lands and development of recreation facilities at Fern Ridge commensurate with conditions under the Fern Ridge modification plan; (b) implementation of the Willamette Greenway (Willamette Recreation Waterway) concept for recreation, fish and wildlife, and environmental preservation; (c) watershed management and improvement programs; (d) flood plain use regulation and zoning as a locally accomplished supplement to the flood control effects of existing and proposed multiple-purpose works; (e) fish and wildlife programs, including those associated with water-level management at Fern Ridge; (f) continued water pollution control programs of the State Department of Environmental Quality; (g) installation of eight small group enterprise jobs on agricultural land involving channel improvement, irrigation development, and improved drainage outlets; and (h) soil and water restoration measures at 6 identified locations on O&C forest lands.

An additional possibility would be the development of thermal power generating facilities.

b. Long-range features. - Long-range features include those identified and needed for which a showing of economic justification is not now available or which, for other reasons should not be implemented at this time. The principal ones are: (1) additional multiple-purpose storage for service both in the subbasin and downstream, (2) additional channel improvement for flood control and drainage, (3) additional irrigation development, (4) additional basin-system channel improvement, and (5) additional recreation facilities at existing developments.

(1) The Noti Reservoir, at site No. 172, on upper Long Tom River would provide storage for local flood control, irrigation, and

limited at-site recreation. Also, it could serve as an additional source of replacement for Fern Ridge storage.

The reservoir would have a capacity in the order of 35,000 acre-feet and would be operated to fill in the fall and early winter before storing was initiated at Fern Ridge. During the summer, as evaporation and downstream releases draw on Fern Ridge storage, water could be released from Noti Reservoir to assist in keeping Fern Ridge near full-pool level.

(2) Watershed projects having the best potential for meeting needs after 1980 are Upper Long Tom River and Lower Long Tom River. Current status of land use, development, and water-related problems for each of those watersheds are shown in Table A-1, Addendum A to Appendix G. Principal structural measures involved in those projects would be: (a) a 14,300-acre-foot reservoir at site No. 157 on Poodle Creek, (b) a 20,000-acre-foot reservoir at site No. 149 on Elk Creek, and (c) about 28 miles of tributary channel improvements.

(3) Additional basin-system channel improvement would be needed during the long-range period. Location, type, and extent of work would have to be determined on the basis of experience, but channel stabilization works on Willamette River probably would be the principal item involved.

(4) Other features. - Private irrigation development, both individual and small group, is expected to continue to the year 2020. However, if irrigation projections are to be realized, a large-scale irrigation project would be necessary. Such a project should logically contain both the East Long Tom area, between Long Tom and Willamette Rivers, and the West Long Tom area which is located in the West Muddy Creek drainage outside of Long Tom Subbasin. A plan was developed to serve 17,700 acres in the East Long Tom and 18,000 acres in the West Long Tom areas. The water available for irrigation purposes in Fern Ridge Reservoir is inadequate to supply that project, and additional water will be required. The most logical source would be Willamette River, using existing storage in upstream Federal reservoirs. A pumping plant on the river below Eugene would lift water to a canal which would extend west nearly 10 miles to Long Tom River downstream from Fern Ridge. Pumping plants on the canal and on Long Tom River would deliver water to project

lands through pressure-pipe distribution systems. The project would pump about 52,000 acre-feet from Willamette River annually in addition to the supply available from Fern Ridge Reservoir under existing authorization.

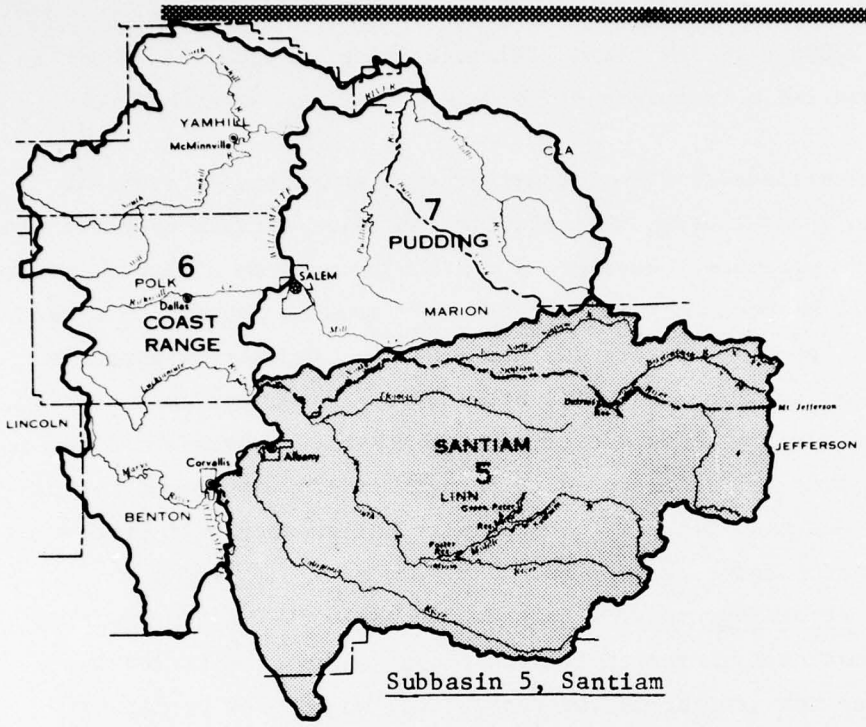
Willamette River, together with existing and proposed reservoirs in the subbasin, will provide the water-surface area required for recreation purposes. However, a continuing program of facility construction will be necessary to meet the ever-growing recreation demand.

Specific storage for municipal and industrial purposes does not appear to be needed until after 2020. The major part of the subbasin's M&I need will be satisfied from McKenzie Subbasin and the small communities can be expected to meet their growing demand through expansion of existing sources. The primary M&I expense will consist of water treatment plant construction.

c. Remaining needs. - As shown in Table IV-7, the principal remaining unmet need is for additional flood control. Some developments, such as for irrigation and recreation, would provide capacity apparently surplus to subbasin needs. A part of the unmet need for flood damage reduction could be met by a locally adopted flood plain use regulation program, and there is a possibility of developing a few flood control projects under Federal small projects programs.

Tables V-6 through 14 summarize, by functions, projected needs and identified water-related accomplishments, generally for subbasin elements, for the plan as a whole.

SUBBASIN 5 - SANTIAM



Subbasin 5, Santiam

The Setting

Subbasin 5, Santiam, consists of the watersheds of Santiam and Calapooia Rivers, and lands along the east bank of Willamette River from the Long Tom Subbasin boundary downstream to Albany. Calapooia and Santiam Rivers have no direct effect one on the other; each is tributary to Willamette River.

The area is about three-fourths forested and one-fourth agricultural. Forest lands include both National Forest and large private holdings. Present and projected population density is more than one-third of the basin average; Albany, at the northwestern edge, is the major population center.

Subbasin streams provide more than one-fourth of the average annual runoff of Willamette River. Ground water resources in the agricultural areas range from considerable to moderate. The Calapooia and South Santiam drainages lie in the Western Cascades subunit, which is lower than the headwaters of North Santiam River. For that reason, summer runoff rates for those streams are much lower than for the rest of the subbasin.

Valley agricultural lands range from rich, well-drained loams in the Santiam flood plain to heavy, slow-draining soils between the Calapooia and Willamette. Dry-land production of rye grass seed in that latter area has caused Linn County to be characterized as the rye grass capital of the world.

Existing Federal multiple-purpose reservoirs include Detroit and Big Cliff on North Santiam, Green Peter on Middle Santiam, and Foster on South Santiam Rivers. Authorized purposes are flood control, navigation, irrigation, and power. In addition, Holley Reservoir on Calapooia River and Cascadia Reservoir on South Santiam River have been authorized for flood control, irrigation, and navigation. A study is currently underway to determine the feasibility of providing increased storage at the Holley site to serve additional functions. That study is scheduled for early completion, and a recommendation for reauthorization of that project at a larger size is expected.

With existing and authorized reservoirs, minimum fish flow could be met through 2020 on Santiam and on North and South Santiam Rivers. Stream temperatures commonly exceed 75°F., and occasionally rise above 80°F., in certain reaches of Calapooia River and Thomas Creek. Stream temperatures elsewhere in the subbasin are generally cooler. Barriers to fish passage exist in Detroit Dam on North Santiam River and at eight other locations in the subbasin. Fisherman-access programs are needed to permit use of warm-water game fish stocks. The principal needs for the cold-water fishery are increased hatchery production, stocking of streams and lakes, and fisherman access. Hunting opportunities are insufficient to meet current demands and are likely to remain so in the future.

Annual flooding occurs on about 50,500 acres in the subbasin. Resulting average annual damages of more than 1 million dollars are projected to almost double by 2020 if no additional flood control measures are taken. The three existing and two authorized reservoirs will provide substantial flood control, but will not be adequate to fully meet the identified needs. Channel stabilization facilities are needed for about 23 miles on major streams in the subbasin, and channel improvements for flood control and drainage are needed on about 145 miles of small tributaries.

Irrigation is expected to increase from the present 54,800 acres to about 232,000 by 2020. The water requirements for such expansion will be in the order of four times the present diversions. A portion of the storage in the existing Detroit, Green Peter, and Foster Reservoirs, and in the authorized Holley and Cascadia Reservoirs, is available for irrigation use. With the exception of a few isolated areas, storage in the existing and authorized reservoirs would be adequate to meet the water demands to 2020. In addition, water can be diverted from McKenzie and Willamette Rivers, numerous farm-pond sites are available, and ground water supplies are abundant along the larger streams.

Natural flows and ground water are the source of municipal and industrial water for the towns and communities in Subbasin 5. It appears that future demands can be met without developing storage for that specific use. Cities obtaining water from South Santiam River could supplement their supplies from storage in existing upstream reservoirs. Some communities in the Calapooia River drainage may have to develop supplemental supplies from ground water or purchase stored water for use during low-flow periods.

There is, and will continue to be, a surplus of water surface area for recreation uses in the subbasin. However, the available recreation facilities meet less than 85 percent of the present demands, and would satisfy less than 20 percent of the 2020 needs. There is a need for special attention to: (1) development of new recreation areas, (2) encouragement of private-sector recreational development, (3) improved public access along Willamette River and lower Santiam and Calapooia Rivers, and (4) development of high-potential recreation sites in the forested Cascade Range.

Water quality in North Santiam River is excellent and is expected to remain so even though a rather large waste load is projected for the future. Increased flows from Green Peter and Foster Reservoirs, together with newly constructed waste treatment plants on South Santiam River, have greatly reduced pollution problems on that stream. Water quality problems on Calapooia River also are expected to be resolved with construction and operation of Holley Reservoir. Therefore, additional storage specifically for water quality purposes is not needed in the subbasin.

Subbasin Rationale

There is ample evidence to warrant further development in Santiam Subbasin. The elements proposed for development have been selected and formulated on the basis of physical and economic feasibility, functional compatibility, capability to serve a variety of needs, and logical location and timing of implementation.

The following discussion shows pertinent subbasin rationale and outlines proposed development features. Table IV-8 summarizes water-related needs and anticipated storage accomplishments as of 2020.

a. Early-action features. - Early-action features include: (1) a modification to the present authorization for Holley Dam and Reservoir, (2) four small watershed projects, (3) two multiple-purpose storage projects, (4) basin-system channel improvements, (5) one irrigation development associated with an authorized Federal storage project, (6) expansion of the recreation facility capacity, (7) an environmental management program, and (8) private-sector irrigation development.

(1) The base-system, authorized, Holley Reservoir would be recommended for reauthorization to serve additional needs. These would include recreation, fish and wildlife enhancement, water supply, and water quality control, from a reservoir of increased capacity.

(2) Small watershed projects include those for the San Thomas, Walton Slough, Grand Prairie, and East Muddy Creek areas. Those four nonstorage developments would serve the functions of flood control, drainage improvement, and irrigation.

Structural measures would consist of about 58 miles of channel improvement for flood control and drainage; an irrigation distribution system for about 3,200 acres in the Grand Prairie area; and rehabilitation and enlargement of the existing Muddy Creek Irrigation Project to irrigate an additional 7,000 acres. Flood control and drainage facilities would reduce the average annual flood plain by about 6,400 acres. Channel improvement work would be coordinated with the fish and wildlife agencies.

(3) Jordan Reservoir on Thomas Creek would be a multiple-purpose storage feature to serve a part of the subbasin needs for flood

Table IV-8

Projected water-related needs and storage accomplishments

Subbasin 5 - Santiam, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments											
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Navigation Flow, cfs	Power Cap., kw	Recreation, 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. *Projected Subbasin Needs:*	-	-	-	-	-	1,281	-	81	-	-	561,900	130,700 2/	0 4/	N/A 5/	6,791	8,791	-
1. Calapooia R. @ Albany	-	-	-	-	-	-	250	-	130,000 6/	327	-	-	-	-	-	-	4-6
2. Santiam R. @ Jefferson	-	-	-	-	-	-	1,900	-	800,000 6/	1,535	-	-	-	-	-	-	50-730
3. S. Santiam R. @ Waterloo	-	-	-	-	-	-	1,050	-	400,000 6/	522	-	-	-	-	-	-	20-40
4. Thomas Cr. @ Scio	-	-	-	-	-	-	215	-	15,000 6/	93	-	-	-	-	-	-	-
5. N. Santiam R. @ Mehama	-	-	-	-	-	-	1,200	-	315,000 6/	552	-	-	-	-	-	-	20-690
B. *Presently Assured Accomplishments:*	1,808,900	-	15,440	-	-	411	7/	17	7/	7/	847,800	130,700	N/A 4/	221,000	8,573 8/	2,090	8/
1. Natural flow and small storage	N/A	-	N/A	-	-	-	-	17	-	-	110,200)		-	3,000)		-	-
2. Storage reservoirs:											)		-	0)	9,573	155	-
Holley (auth.)	97,000	-	2,120	FC,N,I	-	-	-	-	90,000	105)	)		-	0)		115	-
Cascadia (auth.)	160,000	-	1,700	FC,N,I	WS,R,F&W,WQ	-	-	-	145,000	-)	)	130,700	-	80,000)		375	-
Green Peter	430,000	-	3,720	FC,N,I,P	WS,R,F&W,WQ	-	-	-	270,000	-)	345,100)		-	20,000)		395	-
Foster	41,000	-	1,220	FC,P	WS,R,F&W,WQ	-	-	-	30,000	494)	)		-	118,000)		1,050	-
Detroit (incl. Big Cliff Rereg.)	460,900	-	3,680	FC,N,I,P	WS,R,F&W,WQ	-	-	-	300,000	438)	)		-	-	-	-	-
3. Groundwater	-	-	-	-	-	-	-	-	-	-	92,600)		-	-			
C. *Total Residual Needs:*	-	-	-	-	-	810	N/A	84	-	-	14,000	0	0	N/A 5/	(+1,883)	4,691	0
1. Calapooia R. @ Albany	-	-	-	-	-	-	250	-	54,000 6/	322	-	-	-	-	-	-	-
2. Santiam R. @ Jefferson	-	-	-	-	-	-	1,700	-	205,000 6/	603	-	-	-	-	-	-	-
3. S. Santiam R. @ Waterloo	-	-	-	-	-	-	950	-	20,000 6/	28	-	-	-	-	-	-	-
4. Thomas Cr. @ Scio	-	-	-	-	-	-	215	-	15,000 6/	93	-	-	-	-	-	-	-
5. N. Santiam R. @ Mehama	-	-	-	-	-	-	1,060	-	60,000 6/	114	-	-	-	-	-	-	-
D. *New Storage Accomplishments:*	439,000	-	7,480	-	-	498	-	-	7/	7/	14,000	N/A	-	8,000,000	8,881	1,441	-
1. Early-action reservoirs:																	
Jordan, site No. 203	93,000	-	1,880	-	FC,N,I,R,F&W,WS,WQ	235 10/	N/A	-	71,000	76	14,000	N/A	-	-	800	530	-
Lyons, site No. 241	110,000	-	1,500	-	FC,N,R,F&W,WS,WQ	188 10/	N/A	-	102,000	91	0	0	-	-	800	545	-
Holley enlargement	48,000	-	560	-	WS,R,F&W,WQ	70 15/	N/A	-	0	-	0	0	-	-	445	260	-
Subtotals	251,000	-	3,940	-	-	493 10/	-	-	-	-	14,000	N/A	-	-	2,045	1,335	-
2. Long-range reservoirs:																	
Sawmill, site No. 232	70,000	-	620	-	FC,F&W,WQ,P 11/	N/A	N/A	-	56,500	66	-	-	-	11/	-	-	-
Wiley Cr.,site No. 251	65,000	-	1,275	-	FC,F&W,WQ,R	N/A	N/A	-	48,700	51	-	-	-	-	640	125	-
Courtney Cr., site No. 191	6,400	-	160	-	FC,O 12/	-	-	-	2,350	9	-	-	-	-	-	-	-
Sucker Slough, site No. 237	7,200	-	395	-	FC,O 12/	-	-	-	1,250	5	-	-	-	-	-	-	-
Little Muddy Cr site No. 243	3,400	-	90	-	FC,O 12/	-	-	-	600	2	-	-	-	-	-	-	-
Oak Cr., site No. 224	7,200	-	180	-	FC,O 12/	-	-	-	1,600	5	-	-	-	-	-	-	-
Hamilton Cr., site No. 244	12,000	-	330	-	FC,O 12/	-	-	-	6,000	17	-	-	-	-	-	-	-
Bear Branch, site No. 179	16,800	-	490	-	FC,O 12/	-	-	-	3,400	11	-	-	-	-	-	-	-
Snow Peak, Pumped-storage	16,800 13/	-	-	-	P	-	-	-	-	-	-	-	-	4,000,000	-	-	-
Little Meadows, Pumped-storage	5,800 13/	-	-	-	P	-	-	-	-	-	-	-	-	1,000,000	-	-	-
Subtotals	188,000	-	3,540	-	-	-	-	-	-	-	-	-	-	5,000,000	640	125	-
E. *Year 2020 Conditions:*																	
1. *Subbasin storage totals*	1,647,900	-	19,980	-	-	-	-	-	-	-	-	-	-	8,221,009	-	-	-
2. *Unmet needs:*	-	-	-	-	-	317 14/	N/A	84 14/	-	-	0	0	-	N/A 5/	0	3,777 15/	-
Calapooia R. @ Albany	-	-	-	-	-	-	-	-	51,300 6/	208	-	-	-	-	-	-	-
Thomas Cr. @ Scio	-	-	-	-	-	-	-	-	0	17	-	-	-	-	-	-	-
N. Santiam R. @ Mehama	-	-	-	-	-	-	-	-	0	23	-	-	-	-	-	-	-
Santiam R. @ Jefferson	-	-	-	-	-	-	-	-	0	186	-	-	-	-	-	-	-
3. *Additional capacity:*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,237	-	-
Santiam R. @ Jefferson	-	-	-	-	-	-	-	-	11,200	-	-	-	-	-	-	-	-
N. Santiam R. @ Mehama	-	-	-	-	-	-	-	-	35,000	-	-	-	-	-	-	-	-
S. Santiam R. @ Waterloo	-	-	-	-	-	-	-	-	24,000	-	-	-	-	-	-	-	-
Thomas Cr. @ Scio	-	-	-	-	-	-	-	-	82,000	-	-	-	-	-	-	-	-

N/A *Not available for subbasin or location.*

1/ *Additional data are shown in Part V.*
2/ *Additional study to be made; see Part V.*
3/ *Includes subbasin portion of Albany-Corvallis service area municipal needs and all industrial requirements.*
4/ *No need in subbasin; storage releases contribute to meeting Willamette River needs.*
5/ *Projections only on a total-basin basis.*
6/ *Amount, effective at station shown, for control of a 100-year flood.*
7/ *Residual needs and year 2020 figures show effect of accomplishments.*
8/ *Includes Willamette River.*
9/ *Requirements met by natural flows and minimum releases for other purposes.*
10/ *Capacity based on 1M fish per surface acre; management practices discussed in Appendix O required for utilization of potential.*
11/ *In connection with Snow Peak pumped-storage project, to serve as the lower reservoir.*
12/ *Space not fully assigned; some available for other purposes.*
13/ *Closed system; storage therein not available for use outside the system.*
14/ *Can be met by implementation of access and management programs discussed in Appendix O, Fish and Wildlife.*
15/ *Can be met by implementation of programs presented in Appendix K, Recreation.*

control, irrigation, fish and wildlife, recreation, water quality, and possibly municipal and industrial water. The project would control flooding on Thomas Creek and reduce stream flooding on Santiam and Willamette Rivers. The reservoir would be operated to provide an irrigation supply for about 5,500 acres, and to provide additional flows at desirable temperatures for downstream fish and wildlife enhancement. No specific increment of storage for recreation was included, but facilities would be provided and recreation benefits would be expected to occur from use of the reservoir. A tentative reservoir capacity of 93,000 acre-feet would provide 71,000 acre-feet of flood control storage space and a permanent pool for recreation and resident fishery. The City of Scio's municipal and industrial water supplies could be augmented from storage in Jordan Reservoir.

(4) Lyons Reservoir, on Little North Santiam River, would be a multiple-purpose development with particular value for flood control downstream on Santiam and Willamette Rivers. The reservoir would have a surface area of 1,500 acres and a total capacity of 110,000 acre-feet, of which 102,000 acre-feet would be usable for flood control. The reservoir would be operated to provide increased streamflows for water quality and downstream fishery enhancement, a reservoir fishery, and water-oriented recreation. Recreation facilities would be provided. There is a power-generation potential, but further studies will be required to determine whether it should be developed.

(5) Brownsville Unit, Calapooia Division, Willamette River Project would be a single-purpose irrigation development associated with Holley Dam and Reservoir on Calapooia River. Development of the unit would involve construction of distribution facilities to irrigate 8,700 acres in the Brownsville area. Under the plan of development, water would be released from Holley Reservoir into the stream channel, and two downstream pumping plants together with a pipeline distribution system would provide sprinkler pressure delivery to the lands. A drainage system is also included in the plan of development. Alternatively, irrigators could contract with USBR for use of stored water and provide their own diversion facilities. The remaining irrigation potential in the Calapooia Division, some 39,000 acres, is not expected to be developed until later and is included in the long-range phase.

(6) Basin-system channel improvements would be required to permit efficient flood control operation of existing, authorized, and potential new storage. During the early-action period, channel stabilization should be done on Santiam, North Santiam, and South Santiam Rivers, and on Thomas Creek.

(7) Recreation development, in addition to facilities associated with existing, authorized, and proposed reservoirs, would be provided. Such features would include extensive recreation development along Willamette River and subbasin streams. It is anticipated that the activities would incorporate continued action on the Willamette River Parks system, Federal and State assistance to encourage private development, and cooperative Federal agency-private landowner programs.

(8) Other features consist principally of individual and small group efforts in private irrigation development; acquisition and development of four mineral springs to enhance the pigeon habitat and improve hunting opportunities; environmental management of selected streams (See Part V); local programs of flood plain use regulation; installation of 11 small group enterprise jobs on agricultural lands involving channel improvement, irrigation development, and improved drainage outlets; and soil and water restoration measures at 28 identified locations on O&C lands and 29 locations in National forests. Also consideration is being given to a possible nuclear-fueled thermal electric generating installation in the subbasin.

b. Long-range features. - These features include six reservoirs in small watershed projects, two large multiple-purpose storage projects, additional basin-system and tributary channel improvement, expanded irrigation development in association with existing and authorized Federal storage, and additional recreation facility development.

(1) Watershed projects having the best potential for meeting needs after 1980 are Millersburg-Dever, Bear Branch, Thomas Creek, Crabtree Creek, Willamette, and Lake Creek. Current status of land use, development, and water-related problems for each of those watersheds are shown in Table A-1, Addendum A to Appendix G. Principal structural measures involved in those projects would be: (a) a 16,800-acre-foot reservoir at site No. 179 on Bear Branch, (b) a 7,200-acre-foot reservoir at site No. 237 on Sucker Slough, (c) a 7,200-acre-foot

reservoir at site No. 224 on Oak Creek, (d) a 6,400-acre-foot reservoir at site No. 191 on Courtney Creek, (e) a 3,400-acre-foot reservoir at site No. 243 on Little Muddy Creek, (f) a 12,000-acre-foot reservoir at site No. 244 on Hamilton Creek, and (g) about 86 miles of tributary channel improvements. The reservoirs would provide a total of about 53,000-acre-feet of storage space for flood control and conservation uses.

(2) Sawmill Reservoir, on Crabtree Creek, would be a multiple-purpose project with primary emphasis on meeting remaining flood control requirements. Also, it might be highly valuable for production of spring Chinook and coho salmon. A 70,000-acre-foot reservoir would be adequate to provide 56,500 acre-feet of space for flood control and for rearing of anadromous fish. It might also be utilized as the lower reservoir for the potential long-range Snow Peak pumped-storage hydroelectric project, but further studies would be required to determine whether those three uses would be compatible and whether any significant amount of recreation or fish production could be realized at the reservoir.

(3) Wiley Creek Reservoir, on Wiley Creek, a tributary of South Santiam River, would provide a storage impoundment for rearing anadromous fish, flood control, and water-oriented recreation, and perhaps other purposes. The proposed capacity of about 65,000 acre-feet would provide about 48,700 acre-feet of storage space for flood control, and a permanent pool for fish rearing. Recreation facilities would be furnished to utilize recreational opportunities at the site.

(4) Basin-system channel improvement work, in addition to that in the early-action portion of the plan, may be needed on Crabtree Creek as well as on Santiam, North Santiam, and South Santiam Rivers and Thomas Creek. Additional study, based on conditions at a later date, will be required for a final determination.

(5) Irrigation development would be extensive in the long-range phase, particularly in the Calapooia, Scio, Coburg, and Grand Prairie areas. Water supplies for those areas are available in the existing and authorized Federal reservoirs. Development of the Calapooia Project, located generally within the Brownsville-Albany-Lebanon triangle, would bring about 39,000 acres under irrigation in addition to the 8,700 acre Brownsville unit described in the early-action plans.

The irrigation water supply would be obtained from existing Federal storage on South Santiam River and pumped into canals and pipe distribution system for delivery to the farm units. The proposed plan for irrigation development of the Scio Project, located largely between South Santiam and North Santiam Rivers, provides for pumping water supplies from South Santiam, North Santiam, and Santiam Rivers, and diversion from the proposed early-action Jordan Reservoir. Canals and pipe distribution systems would carry the water to the farmlands. About 21,500 acres would be supplied from storage in the existing reservoirs and the remainder, 5,500 acres, from storage in the proposed Jordan Reservoir. The Coburg Project, mostly in the East Muddy Creek drainage, would be developed to irrigate about 48,000 acres by 2020. In the total area, the East Muddy Creek Watershed Project will provide irrigation for about 7,000 acres in the early-action phase, and it is expected ultimately an additional 73,000 acres will be under irrigation. Use of existing Federal storage on McKenzie and Willamette Rivers appears to be the most logical and economical source of water for the Coburg area lands. The Grand Prairie area, located generally between South Santiam and Willamette Rivers includes the Grand Prairie Watershed Project which is planned to serve about 3,300 acres. There is, however, a sizable remaining irrigation potential in the area. Expansion of the Grand Prairie Watershed Project could bring in an additional 12,700 acres. Irrigation water supplies for the extension lands would be obtained from natural flows and/or stored water in South Santiam River.

It is expected that private irrigation development will continue to year 2020 and beyond. Individuals and small groups will utilize ground water, farm ponds, and storage in Federal reservoirs to irrigate small tracts both within and outside of the larger project areas described previously.

(6) Two pumped-storage power sites in Subbasin 5 appear promising and should be considered for development after 1990. Those projects are included in the long-range plan based on the premise that there will be a definite need in the basin for large amounts of peaking capacity, and that they could be developed without significant adverse effects to fish, wildlife, and recreation. The two proposals are Snow Peak, which would be associated with the Sawmill Dam and Reservoir on

Crabtree Creek, and Little Meadows which would be located on Quartzville Creek, a tributary to Middle Santiam River. The Snow Peak facility would pump water from Sawmill Reservoir into another reservoir some 2,200 feet higher in elevation. The water released back into Sawmill Reservoir would generate about 4 million kilowatts. Some fluctuation in Sawmill Reservoir would result during the periods of power generation, but not significant enough to prevent operation for flood control. Further studies would be required to evaluate the effect on anadromous fish rearing, resident trout, the overall environment, and recreation. Little Meadows pumped-storage works would involve reservoirs at Little Meadows and on Quartzville Creek, one about 1,600 feet higher than the other. About 1 million kilowatts of peaking power could be generated at that facility. A potential nuclear-fueled generating plant could provide some of the pumping power required.

(7) Other features involve the recreational opportunities within this subbasin. Those opportunities are tremendous and the demand will necessitate a continuing program of recreation facility construction during the long-range period. Cooperation between Federal, State, and local governmental entities and the private sector will be needed to provide and operate recreation facilities on the many lakes, streams, and reservoirs in the subbasin.

A few communities may find it advantageous to obtain water supplies from storage in Federal reservoirs, but most can meet their demands through expansion of existing sources. A continuing program of water treatment plant construction will be required if satisfactory water quality standards are to be maintained.

c. Alternatives and opportunities. - There remain, beyond the plan, several development opportunities available within the subbasin, especially in the area of hydroelectric power generation.

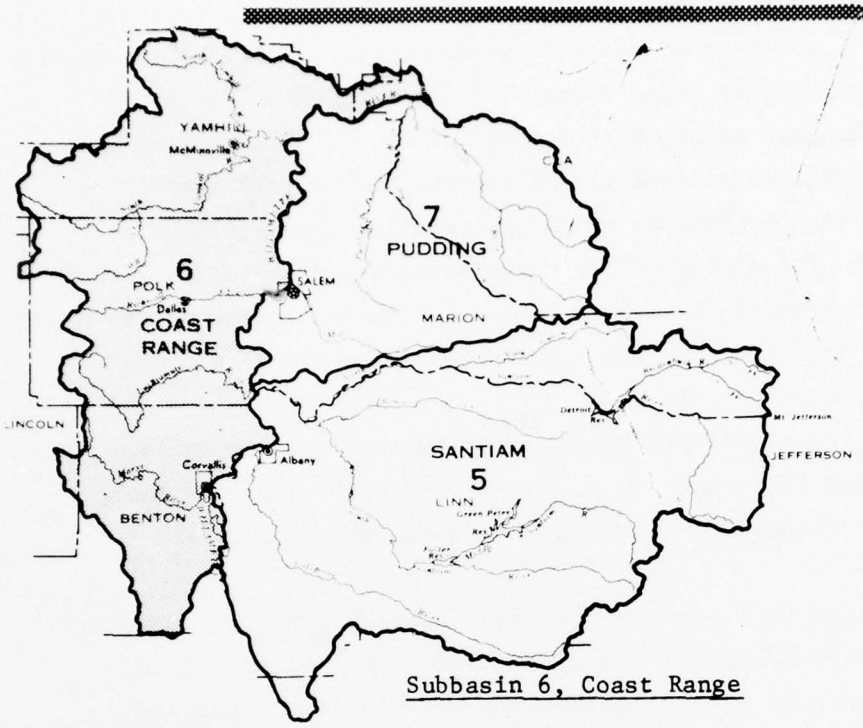
The sizable potential for power development is in three opportunity types: (1) multiple-purpose projects, (2) single-purpose hydroelectric projects, and (3) pumped-storage works. Eight potential multiple-purpose project sites, with a total installed generating capacity of 195,000 kilowatts, have been identified. Development of those sites should be considered only if potential for service to other functional

needs can be established, and if development needs outweigh needs for preservation of natural environment and recreation potentials. There are two potential single-purpose hydroelectric power production sites, one on North Santiam River and one on Marion Creek, which appear to be economically feasible. However, both developments would be in conflict with the early-action environmental program, would adversely affect recreational resources of the subbasin, and are not included in the plan. Ten additional pumped-storage sites have been identified, but are not included in the plan because of economic reasons and conflicts with the environmental preservation program.

d. Remaining needs. - Table IV-8 shows that existing, authorized, and proposed developments would essentially meet all of the functional needs for storage in the subbasin. The principal unmet needs would be for more flood control storage in the Calapooia River drainage, and possibly for additional flows to meet anadromous fish requirements. Storage available on North and South Santiam Rivers and tributaries would exceed the indicated subbasin needs for control of a 100-year flood and available water area could be developed to more than serve projected recreation needs for the total subbasin. The apparent surplus of flood control storage would permit control of larger floods than 100-year frequency level, and would contribute to flood stage reductions downstream. However, there would remain an excessive amount of area from which flood runoff would not be controlled.

Tables V-6 through 14 summarize, by functions and generally for each subbasin, the remaining total basin needs and additional capacities for services in excess of projected basin needs.

SUBBASIN 6 - COAST RANGE



Subbasin 6, Coast Range

The Setting

Subbasin 6, Coast Range, consists of all the area between the crest of the Coast Range and Willamette River, from Long Tom Subbasin on the south to Tualatin Subbasin on the north. Principal streams are Marys, Luckiamute, and Yamhill Rivers and Rickreall Creek. Each of these streams drains directly into Willamette River. Subbasin streams are characterized by high, flashy flood peaks, caused by direct and carry-over precipitation during intense winter storms, and low-to-almost-nonexistent summer flows. About 56 percent of the subbasin is forested and about 38 percent is agricultural. Most of the forest lands are in private ownership. Most of the public land is administered by BLM. The cities of Salem and Albany lie on the east edge of the subbasin. Corvallis is the principal population center in the subbasin. Population density is about one-half the basin average.

Water and land resource development has been slow in the subbasin. There are no existing or authorized major reservoirs, and less than 100 total acres of water surface on small private and municipal reservoirs. No significant amount of unappropriated natural flow remains in the

streams of the subbasin during low-flow season. Further, a major part of the subbasin is poorly supplied with ground water. However, potentially highly productive aquifers exist along Willamette River and in a few other scattered areas. Water, both natural flows and storage releases, is available in Willamette River for diversion into the subbasin.

The present economy depends primarily upon the forest and agricultural industries. The slopes of the Coast Range are principally forest lands; however, a majority have been logged. Although reforestation is practiced, it is expected that the importance of the timber and wood products industries will diminish.

The lowlands along Willamette River and in the interior valleys amount to more than 25 percent of the basin's irrigable lands. Thus, agriculture is expected to continue as a mainstay of the subbasin economy.

Warm, low flows in the summer and fall severely limit the fishery resource. Stream temperatures commonly exceed 70°F. and occasionally rise to 80°F. Barriers to fish passage include five small dams and five natural falls. To meet projected demands for resident fishery would require new impoundments and fish production and fisherman access programs.

Supplies of most wildlife species are insufficient to meet current demands. Specific wildlife needs include acquisition and development of several mineral springs for enhancement of pigeon hunting. Needs associated with the W. L. Finley and Baskett Slough Wildlife Refuges are for additional water supplies, habitat improvement, and public-use facilities.

Annual flooding occurs on about 52,000 acres in the subbasin. Some channel improvement and stabilization work has been done, but there are no flood control reservoirs in the subbasin. Reduction of flood damages will require storage at several locations. In addition to the need for impoundments, there are identified needs for about 135 miles of channel improvements and stabilization works.

Less than 10 percent of the nearly 450,000 irrigable acres in the subbasin are irrigated, and a tremendous opportunity for irrigation development exists. It is expected that more than 300,000 acres would be irrigated by 2020. Unappropriated natural flow during the irrigation season is practically nonexistent in the subbasin streams; however,

there is a considerable amount of water available for diversion to the subbasin from existing upstream reservoirs in the Willamette system. Also, the potential ground water producing areas are expected to sustain several times the present use. There is a considerable portion of the lands, however, which are not within economic serving distance of the ground water areas or Willamette River. Irrigation of those lands will require new storage within the subbasin.

Municipal and industrial water supplies, although presently adequate in most cases, will need expansion to meet projected population growth, especially for the larger municipalities, such as Corvallis. It appears that Corvallis will have to increase its water rights and diversion from Willamette River, or obtain supplies from new storage development. Other municipalities which will require additional storage include Sheridan and Monmouth, and a few smaller communities may desire to participate in Federal or Federally-assisted projects.

Difficult access has limited the use of much of the natural recreation features, such as the timbered mountains and Willamette River. Present recreation facility capacity in the subbasin would satisfy only about 30 percent of the 1980 needs and about 15 percent of the 2020 needs in recreation days. There is little water surface, except for Willamette River, available for public use within the subbasin. Multiple-purpose storage reservoirs with appropriate recreation facilities, extensive recreation development along Willamette River and subbasin streams, and public access programs will be needed to meet future demands.

Minimum streamflows for water quality purposes have been identified for Marys, South Yamhill, and Yamhill Rivers. The requirements are not exceptionally high, and are met by natural flows.

Subbasin Rationale

The ground water resource is small, except in alluvium along Willamette River and portions of Luckiamute and Yamhill Rivers. Thus, it appears that use of existing upstream storage and development of new storage in the subbasin hold the greatest potential to best satisfy present and projected needs. With the general absence of water resource development, Federal lands, and major Federal reservoirs, there is both a need and the opportunity for non-Federal and private-sector development,

particularly in the fields of recreation, irrigation, and M&I supplies. Also, there are opportunities for development of waterfowl and upland-game management and shooting areas as a source of farm income. At the same time, there are needs and opportunities for development of Federal and Federally assisted projects. The Bureau of Land Management could make a considerable contribution towards meeting recreation needs in this area. They should formulate a plan for public access, scenic drives, and interpretive and use facility development. This subbasin appears to have the most prospect for change in character during the next 50 years of any in Willamette Basin. The following discussions show pertinent subbasin rationale and describe the proposed development features. Table IV-9 presents a statistical summary of the water-related needs and anticipated storage accomplishments as of 2020, in units as used in subbasin analysis.

a. Early-action features. - Early-action features include nine small watershed projects, five multiple-purpose storage developments, two single-purpose irrigation projects, basin-system channel improvements, an environmental management program, and fish and wildlife habitat improvement.

Four major independent drainages--Marys River, Luckiamute River, Rickreall Creek, and Yamhill River--make up Subbasin 6. Early-action features, except fish and wildlife works and miscellaneous other works, are discussed separately for those four drainages.

(1) Marys River is the southernmost of the four principal subbasin drainages. It contains the City of Corvallis, the principal population center of the subbasin. Proposed early-action elements in the Marys River drainage are:

(a) West Muddy Creek Watershed Project would be a multiple-purpose development to serve the needs of flood control, irrigation, recreation, and drainage. Three reservoirs--at site numbers 259, 299, and 310--would provide an aggregate capacity of about 32,000 acre-feet and a total surface area of about 900 acres. In addition to storage and related facilities, the project would include provisions to meet associated land treatment needs, about 31 miles of channel improvement, and an irrigation distribution system. Project facilities would reduce the average annual flood plain by about 3,650 acres, and provide an

Table IV-9
Projected water-related needs and storage accomplishments
Subbasin 8 - Coast Range, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments										
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Naviga-tion Flow, cfs	Power Cap., kw	Recreation, 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish 1,000's	Anad-romous, Flow,cfs	Warm Water, No. of Fish 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. *Projected Subbasin Needs:*	-	-	-	-	-	*143*	-	*145*	-	-	*754,600*	*88,400*	*0 3/*	*N/A 4/*	*6,260*	*8,260*	*N/A*
1. Marys R. @ Philomath	-	-	-	-	-	-	75	-	50,000 5/	126	-	-	-	-	-	-	5-7
2. Luckiamute R. nr. Suver	-	-	-	-	-	-	200	-	105,000 5/	204	-	-	-	-	-	-	-
3. Rickreall Cr. @ mouth	-	-	-	-	-	-	80	-	N/A	-	-	-	-	-	-	-	-
4. S. Yamhill R. @ Sheridan	-	-	-	-	-	-	225	-	-	-	-	-	-	-	-	-	-
5. S. Yamhill R. @ Whiteson	-	-	-	-	-	-	90	-	145,000 5/	384	-	-	-	-	-	-	10-40
6. N. Yamhill R. @ Pike	-	-	-	-	-	-	70	-	17,000 5/	49	-	-	-	-	-	-	-
7. N. Yamhill R. @ mouth	-	-	-	-	-	-	70	-	N/A	-	-	-	-	-	-	-	-
8. Yamhill R.	-	-	-	-	-	-	90	-	- 6/	-	-	-	-	-	-	-	20-70
B. *Presently Assured Accomplishments:*	*0*	-	*0*	-	-	*48*	*0*	*82*	*0*	-	*369,650*	*76,400*	*N/A 3/*	*0*	*6,731 7/*	*0*	*8/*
1. Natural flow and small storage	N/A	-	N/A	-	-	48	0	82	0	-)	)		-	-	6,731	-	-
Luckiamute R. nr. Suver	-	-	-	-	-	-	0	-	-	-)	9/)		-	-	-	-	-
Rickreall Cr. @ mouth	-	-	-	-	-	-	0	-	-	-)	311,750)	76,400	-	-	-	-	-
S. Yamhill R. @ Sheridan	-	-	-	-	-	-	-	-	-	-)	)		-	-	-	-	-
2. Storage reservoirs	-	-	-	-	-	-	-	-	-	-	57,900)		-	-	-	-	-
3. Groundwater	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-
C. *Total Needful Needs:*	-	-	-	-	-	*96*	-	*160*	-	-	*884,250*	*12,000*	*0*	*N/A 4/*	*1,619*	*8,260*	*0*
1. Marys R. @ Philomath	-	-	-	-	-	-	75	-	50,000 5/	126	-	-	-	-	-	-	-
2. Luckiamute R. nr. Suver	-	-	-	-	-	-	200	-	105,000 5/	204	-	-	-	-	-	-	-
3. Rickreall Cr. @ mouth	-	-	-	-	-	-	80	-	N/A	-	-	-	-	-	-	-	-
4. S. Yamhill R. @ Sheridan	-	-	-	-	-	-	225	-	-	-	-	-	-	-	-	-	-
5. S. Yamhill R. @ Whiteson	-	-	-	-	-	-	90	-	145,000 5/	384	-	-	-	-	-	-	-
6. N. Yamhill R. @ Pike	-	-	-	-	-	-	70	-	17,000 5/	49	-	-	-	-	-	-	-
7. N. Yamhill R. @ mouth	-	-	-	-	-	-	70	-	N/A	-	-	-	-	-	-	-	-
8. Yamhill R.	-	-	-	-	-	-	90	-	-	-	-	-	-	-	-	-	-
D. *Summary, New Storage Accomplishments:* 10/	*648,790*	-	*18,168*	-	-	*5,911*	*N/A*	-	*11/*	*11/*	*369,380*	*12,000*	-	*0*	*5,403*	*4,744*	*0*
1. Early-action storage:																	
Marys R. area	147,200	-	2,445	-	-	248 12/	-	-	81,450	110	44,600	10,000	-	-	1,004	864	-
Luckiamute R. area	164,600	5,000	4,580	-	-	526 12/	-	-	99,500	135	33,600	3,000	-	-	1,104	790	-
Rickreall Cr. area	6,100	2,400	310	-	-	24 12/	-	-	1,560	4	-	-	-	-	57	57	-
Yamhill R. area 10/	391,950	2,900	8,935	-	-	1,341 12/	225	-	186,140	248	274,250		-	-	3,148	2,953	-
Subtotals 10/	709,850	-	16,470	-	-	2,139 12/	N/A	-	-	-	352,450	13,000	-	-	5,313	4,664	-
2. Long-range reservoirs:	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marys R. area	-	-	-	-	-	-	-	-	2,500	10	16,900	-	-	-	-	-	-
Luckiamute R. area	28,500	-	420	-	-	53	-	-	25,000	31	-	-	-	-	215	50	-
Rickreall Cr. area	30,000	-	420	-	-	19	-	-	17,890	48	-	-	-	-	75	30	-
Yamhill R. area	90,440	-	1,795	-	-	72	N/A	-	-	-	16,900	-	-	-	290	80	-
Subtotals	138,940	-	2,685	-	-												
E. *Year 2020 Conditions:*																	
1. *Unmet needs:*	-	-	-	-	-	*0*	-	*160 13/*	-	-	*16,600*	*0*	-	*N/A 4/*	*0*	*3,604 14/*	-
Marys R. @ Philomath	-	-	-	-	-	-	-	-	*50,500 6/*	*59*	-	-	-	-	-	-	-
Luckiamute R. nr. Suver	-	-	-	-	-	-	-	-	*86,600 6/*	*180*	-	-	-	-	-	-	-
S. Yamhill R. @ Whiteson	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*4,084*	-	-
2. *Additional capacity:*	-	-	-	-	-	*5,116 15/*	-	-	*16,000*	-	-	-	-	-	-	-	-
Marys R. @ Philomath	-	-	-	-	-	-	-	-	*37,000*	-	-	-	-	-	-	-	-
N. Yamhill R. @ Pike	-	-	-	-	-												
F. *Details, New Storage Accomplishments:*																	
1. Early-action, Marys R. area:																	
Beaver Cr., site No. 259	13,000	-	340	-	1	-	-	-	16/	-)	18,600	-	-	-	-	-	-
Reese Cr., site No. 310	9,600	-	320	-	1	-	-	-	16/	-)	-	-	-	-	-	-	-
Oliver Cr., site No. 299	9,600	-	260	-	FC,R	37	-	-	3,450	13	-	-	-	-	104	104	-
Noon, site No. 374	115,000	-	1,725	-	FC,I,R,WS,F&W,WQ	216	-	-	78,000	97	26,000	10,000	-	-	900	760	-
Subtotals	147,200	-	2,645	-	-	248	-	-	81,450	110	44,600	10,000	-	-	1,004	864	-
2. Early-action, Luckiamute R. area:																	
Pedee, site No. 302	130,000	-	3,700	-	FC,I,R,F&W,WQ	462	-	-	93,500	115	18,000	-	-	-	900	630	-
Black Rock, site No. 260	6,000)	5,000 17/	160	-	FC	-	-	-	6,000	20	-	-	-	-	-	-	-
Teal Cr., site No. 330	25,000)		510	-	I,R,WS,Q 18/	64	-	-	16/	-	12,000	3,000	-	-	204	160	-
Steele Cr., site No. 316	3,600	-	216	-	I	-	-	-	16/	-	3,600	-	-	-	-	-	-
Subtotals	164,600	-	4,586	-	-	526	-	-	99,500	135	33,600	3,000	-	-	1,104	790	-
3. Early-action, Rickreall Cr. area:																	
N. Fk. Ash Cr., site No. 291	3,000)	2,400	190	-	FC,R	24	-	-	840	2	-	-	-	-	57	57	-
N. Fk. Ash Cr., site No. 296	3,100)	-	120	-	FC,O 18/	-	-	-	720	2	-	-	-	-	-	-	-
Subtotals	6,100	-	310	-	-	24	-	-	1,560	4	-	-	-	-	57	57	-

Table IV-9 (cont'd)
Projected water-related needs and storage accomplishments
Subbasin 6 - Coast Range, 2020

Item	Storage Project Data 1/ Capacity, ac.-ft. Total	To be Assigned 2/	Full Pool Area, acres	Functions to be Served Auth.	New	Subbasin Needs and Accomplishments: Fish Life Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs	Warm Water, No. of Fish, 1,000's	Flood Control ac.-ft.	sq. mi.	Diversions, ac.-ft. Irrigation	Mbl Supply	Navigation Flow, cfs	Power Cap., kw	Recreation, 1,000 rec.-days Resource Capacity	Facilities	Water Quality Control, cfs
F. *Details, New Storage Accomplishments* (cont'd)																	
4. Early-action, Yamhill R. area:																	
Gorge, site No. 281	53,000	-	560	-	I,FC,R,F&W	70	-	-	25,000	31	49,500	-	-	-	67	67	-
Pike, site No. 306	75,000	-	1,200	-)	I,FC,R,F&W	375	-	-	57,000	66)	75,000	-	-	-	450	450	-
Moores Valley, site No. 292	30,000	-	700	-)		219	-	-	-	-)		-	-	-	350	350	-
Unnamed trib., site No. 578	2,400)	1,900	80	-)	FC,I,O 18/	-	-	-	340	2)	2,800	-	-	-	-	-	-
Unnamed trib., site No. 581	2,300)		130	-)		-	-	-	300	2)		-	-	-	-	-	-
Palmer Cr., site No. 300	11,550	-	690	-	I,R	86	-	-	-	-	5,800	-	-	-	345	150	-
W. Fk. Salt Cr., site No. 577	9,500)	1,000	140	-)	I,R,O 18/	18	-	-	16/	-	4,950	-	-	-	56	56	-
Salt Cr., site No. 558	8,400)		680	-)		-	-	-	16/	-	8,400	-	-	-	-	-	-
Spring Valley, site No. 315	4,800	-	200	-	I	-	-	-	16/	-	4,800	-	-	-	-	-	-
Agency, site No. 253	3,000	-	2,520	-	I,R,FC,F&W	190)	225	-	46,500	64	56,000	-	-	-	1,040	1,040	-
Buck Hollow, site No. 261	44,000	-	1,120	-	I,R,FC,F&W	210)		-	43,500	61	38,000	-	-	-	450	450	-
Gopher Valley, site No. 269 19/	33,000	-	915	-	I,R,FC,F&W	173	-	-	13,500	22	29,000	-	-	-	390	390	-
Deer Cr., site No. 269 20/	18,000)	3,900	700	-)	I,R,O 18/	-	-	-)	16/	-)	15,600	-	-	-	-	-	-
Muddy Cr., site No. 293 20/	18,400)		600	-)		75	-	-)		-)		-	-	-	240	240	-
Subtotals 10/	391,950	-	8,935	-	-	1,341	-	-	186,140	-	274,250	-	-	-	3,148	2,953	-
Total Early-Action Reservoirs 10/	*708,860*	-	*16,470*	-	-	*2,139*	*N/A*	-	-	-	*288,460*	*13,000*	-	-	*5,318*	*4,864*	-
5. Long-range, Marys R. area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. Long-range, Luckiamute R. area:																	
Sulphur Spring, site No. 317	13,000	-	320	-	FC,O 18/	-	-	-	2,500	10	11,400	-	-	-	-	-	-
Grant Cr., site No. 575	5,500	-	150	-	I	-	-	-	16/	-	5,500	-	-	-	-	-	-
Subtotals	18,500	-	470	-	-	-	-	-	2,500	-	16,900	-	-	-	-	-	-
7. Long-range, Rickreall Cr. area:																	
Dallas, site No. 268	30,000	-	420	-	FC,R,F&W,WQ	53	-	-	25,000	31	-	-	-	-	215	50	-
8. Long-range, Yamhill R. area:																	
Salt Cr., site No. 576	3,600	-	135	-	FC,O 18/	-	-	-	790	3	-	-	-	-	-	-	-
Spring Brook, site No. 580	2,640	-	150	-	R,O 18/	19	-	-	-	-	-	-	-	-	-	-	-
Rowell Cr., site No. 584	26,700	-	380	-	FC,O 18/	-	-	-	4,600	12	-	-	-	-	75	30	-
Panther Cr., site No. 301	19,500	-	340	-	FC,O 18/	-	-	-	4,000	12	-	-	-	-	-	-	-
Baker Cr., site No. 256	14,600	-	340	-	FC,O 18/	-	-	-	4,800	15	-	-	-	-	-	-	-
Tindle Cr., site No. 318	11,700	-	270	-	FC,O 18/	-	-	-	2,200	6	-	-	-	-	-	-	-
Ead Cr., site No. 585	11,700	-	180	-	FC,O 18/	-	-	-	1,500	-	-	-	-	-	-	-	-
Subtotals	90,440	-	1,795	-	-	19	-	-	17,890	-	-	-	-	-	75	30	-
Total Long-Range Reservoirs	*138,940*	-	*2,888*	-	-	*72*	-	-	-	-	*16,900*	-	-	-	*290*	*80*	-
Total Reservoirs, Year 2020 10/	*848,790*	-	*19,188*	-	-	*2,211*	-	-	-	-	*305,360*	*13,000*	-	-	*5,608*	*4,744*	-

N/A Not available for subbasin or location.

1/ Additional data are shown in Part V.
2/ Additional study to be made; see Part V.
3/ No need in subbasin; storage releases contribute to meeting Willamette River needs.
4/ Projection available only on a total-basin basis.
5/ Amount, effective at station shown, for control of a 100-year flood.
6/ Flood stage controlled by Willamette backwater.
7/ Includes Willamette River.
8/ Requirement met by natural flows.
9/ Includes stored water from Willamette River diverted through Subbasin 4.
10/ Based on the Gopher Valley alternative; see footnotes 19/ and 20/.
11/ Year 2020 figures show effect of accomplishment.
12/ Capacity based on 116 fish per surface acre; management practices discussed in Appendix D required for utilization of potential.
13/ Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.
14/ Can be met by implementation of programs presented in Appendix K, Recreation.
15/ At present angler success ratio; additional fish would be used, to the extent available.
16/ Incidental to filling for purpose or purposes shown.
17/ Would provide the 3,000 ac.-ft. M&I supply shown.
18/ Space not fully assigned; some available for other purposes.
19/ Part of South Yamhill Project; site also being considered for local development under P. L. 83-566 or P. L. 84-984 (see footnote 20/).
20/ Development, under P. L. 83-566, would be part of two-dam alternative to Gopher Valley.

irrigation water supply to 7,600 acres. Project reservoirs would provide about 6 percent and 2 percent, respectively, of the drainage-area-control and flood-storage requirements for Marys River at mile 5.6, its confluence with West Muddy Creek. Recreation facilities at site number 299 would be capable of serving an initial annual use of 50,000 visitor-days.

(b) Noon Dam and Reservoir, at site number 574 on Marys River, would have the capability to meet a substantial block of multiple-purpose needs, particularly recreation and flood protection. The reservoir would be sized to about 115,000 acre-feet to provide space for flood control and conservation purposes. Conservation storage required for fish flows, irrigation, and municipal and industrial water would be obtained from joint-use pool. Recreational facilities would be provided at the reservoir.

There are about 10,000 acres downstream from the Noon site which could best be irrigated from storage on Marys River. Although those lands are not expected to be irrigated for some time, water would be reserved in Noon Reservoir to meet the future demands.

The City of Corvallis obtains its water supply from the fully-utilized Rock Creek, and from Willamette River. It would probably look to participation in a storage project for additional water to meet future demands.

(c) Basin-system channel improvement along Marys River would be required for efficient flood control operation of Noon Reservoir. The work would consist of channel stabilization and some clearing and cleanup.

(d) Environmental management, except for the area related to the proposed Noon Reservoir, would maintain the desirable natural features of Marys River. Because much of the stream is on private land, implementation would have to be on the basis of individual landowner action.

(2) Luckiamute River is tributary to Willamette River downstream from Marys River. There are no large population centers in the drainage. Proposed early-action elements in the drainage are:

(a) Small watershed projects include those for Little Luckiamute River and Soap Creek areas. Those projects would be developed

to meet local needs for flood control and drainage, irrigation, and recreation, including reservoir fisheries where appropriate. The two projects include three reservoirs with an aggregate storage capacity of about 34,600 acre-feet, and a total surface area of roughly 880 acres. In addition to storage and related facilities, the projects would include provision to meet land treatment needs, about 9.5 miles of channel improvement and an irrigation water supply and distribution system to serve about 5,200 acres. The project would reduce the average annual flood plain by about 1,650 acres. Recreation facilities would be provided at site number 550 on Teal Creek to serve an initial annual use of 80,000 visitor-days. Project reservoirs would provide about 10 percent and 4 percent, respectively, of the drainage-area-control and flood-storage requirements at the downstream Suver control point on Luckiamute River. Also included is 5,000 acre-feet of storage capacity which could be used to satisfy about 21 percent of the summer low-flow requirement at Suver. Specific assignments, or sizing changes, would be made during preconstruction planning by project sponsors and concerned agencies. Consideration will be given to making fish and wildlife enhancement a project purpose.

(b) Pedee Dam and Reservoir is included in the early-action phase primarily for its capability to control floods and provide water surface for recreation. In addition, the project would furnish a portion of the subbasin's water needs for irrigation and a reservoir angling potential. The reservoir would have a capacity of about 130,000 acre-feet and a surface area of 3,700 acres. Use of about 93,500 acre-feet of storage space would control a 100-year flood at the site. There are about 7,000 acres of irrigable land which can best be served from storage on Luckiamute River. Water would be reserved in joint-use space in Pedee Reservoir to supply those lands even though irrigation development is not expected for some time. Minimum flows for fish life would be maintained downstream from the dam and provisions made for facilities to regulate temperature of the releases. Recreation facilities would be provided at the reservoir.

(c) Basin-system channel improvement, consisting of channel stabilization and some clearing and cleanup, would be required on Luckiamute River. The work, to be planned in cooperation with fish

and wildlife agencies, would be limited to that necessary for efficient operation of flood control storage.

(3) Rickreall Creek is tributary to Willamette River just upstream from Salem. Dallas is the principal city in the drainage. Proposed early-action plan elements in the drainage would be:

(a) Ash Creek Watershed Project, near Dallas, would be developed primarily to serve the needs of flood protection, drainage, and recreation. The major structural features would be two reservoirs with a combined capacity of about 6,100 acre-feet and a total surface area of 310 acres, and about 11 miles of channel improvement. The project would reduce the average annual flood plain by about 630 acres. Recreation facilities at site number 291 would serve an initial annual use of 24,000 visitor-days. Additional storage space, in the order of 2,400 acre-feet, for which there is no specific assignment at this time, would be provided in the reservoirs. Decision as to the extent and use of the unassigned space would be made during later detailed investigations.

(b) Monmouth-Dallas Project, 10 miles west of the City of Salem, would be a single-purpose irrigation development utilizing natural flows of Willamette River. A feasibility planning report is presently awaiting Congressional action, and the participating landowners have organized the Monmouth-Dallas Irrigation District. Initially, some 17,200 acres would be irrigated, but the project features would be designed and constructed to ultimately serve 28,000 acres. Principal features include a pumping plant near Buena Vista on the west bank of Willamette River; a main canal; three relift pumping plants; and minor canals, laterals, and drains.

(c) Environmental management, except for the long-range Dallas Reservoir, is proposed to maintain the desirable natural aspects of Rickreall Creek. Cooperation by the City of Dallas and private landowners would be required for implementation.

(4) Yamhill River drainage lies immediately south of Tualatin Subbasin. McMinnville is the largest city. Proposed early-action elements in and adjacent to the drainage would be:

(a) Small watershed projects are those for the Chehalem Creek (tributary to Willamette), Salt Creek, Palmer Creek,

Spring Valley, and Deer Creek areas. Those projects would be developed to meet local needs for flood control and drainage, irrigation, recreation, and possibly fish and wildlife enhancement. The five projects include eight multiple-purpose reservoirs with an aggregate capacity of about 75,000 acre-feet, and a total surface area of more than 3,000 acres. In addition to storage and related facilities, the projects would provide associated land treatment measures, about 22 miles of channel improvement for flood control and drainage, and an irrigation distribution system. Channel improvement would be closely coordinated with the fish and wildlife agencies.

Project facilities would reduce the average annual flood plain by about 1,100 acres, and provide an irrigation water supply for roughly 14,300 acres. Provision would be made for initial recreation use estimated to be in the order of 184,000 visitor-days annually. Project reservoirs include about 6,800 acre-feet of storage capacity which could be used to satisfy about 10 percent of the summer low-flow requirement at Whiteson on South Yamhill River. Specific assignments, or sizing changes as appropriate, will be made in further studies in cooperation with project sponsors and concerned agencies. Consideration will be given to making fish and wildlife a project function.

Reservoirs at site numbers 315 in the Spring Valley Project, and 300 in the Palmer Creek Project, would provide irrigation service alternative to use of existing and authorized upstream Federal storage. If that source were used, the single-purpose project at site number 315 probably could not be justified, and the multiple-purpose project at site number 300 would require a reevaluation for justification. Ground water is also an alternative source of supply in these areas, requiring further evaluation in detailed planning.

The reservoir at site number 269 in the Deer Creek Project would be an alternative to storage in the Gopher Valley Reservoir, at the same site, which is being investigated as an element of the multiple-purpose South Yamhill Project. That site is also being considered for development under the Small Reclamation Projects Loan Program PL 84-984. Any one of those alternatives could be integrated into the plan of development for the South Yamhill area. Further studies will

provide the basis for a final selection.

(b) Red Prairie Project would be a multiple-purpose development to serve the functions of flood control, irrigation, recreation, and fish and wildlife. A feasibility report on the project is under review prior to transmittal to Congress for action, and an irrigation district has been formed by landowners in the area. The 53,000-acre-foot Gorge Reservoir on Mill Creek would provide a water supply for 15,500 irrigable acres; be operated to provide flood control in the lower reaches of Mill Creek and in the town of Sheridan; create a significant reservoir fishery and provide for the enhancement of the anadromous fishery in Mill Creek; and provide a water-surface area for an expected recreation use of 67,000 days annually. Recreation facilities would be provided at the reservoir. Also included in the plan are provisions to deliver 1,500 acre-feet of water annually to the Baskett Slough Wildlife Refuge for wildlife habitat improvement.

(c) Carlton Project, encompassing the North Yamhill River and Chehalem Creek drainages would be a multiple-purpose project serving the functions of irrigation, flood control, recreation, fish and wildlife, and possibly municipal and industrial water supply. Two reservoirs, Pike on North Yamhill River and Moores Valley on Haskins Creek, with a combined capacity of about 105,000 acre-feet and a total surface area of 1,900 acres, were selected after careful screening of potential sites in the North Yamhill drainage. Two other North Yamhill sites evidenced serious stability problems, and two sites on Panther and Baker Creeks were shown to be relatively expensive to develop. Functional features of the project would be irrigation service to about 30,000 acres; 100-year-frequency flood control at Pike Dam; minimum flows and some temperature reduction in North Yamhill River; reservoir angling and recreational activities, and a possible augmentation of municipal water supplies for several communities in the area.

(d) South Yamhill Project would optimize service to water needs in the Yamhill drainage. The project would be a multiple-purpose development to serve the functions of irrigation, flood control, recreation, and fish and wildlife. Three reservoirs, Agency, Buck Hollow, and Gopher Valley, with a combined capacity of 195,000 acre-feet and a total surface area of about 4,500 acres, would be the principal project

structures. The 78,000-acre-foot Agency Reservoir on South Yamhill River would be operated to provide adequate storage space to control a 100-year frequency flood at the site; provide an irrigation water supply to serve about 22,800 acres; and an inactive pool of about 12,000 acre-feet to maintain a reservoir fishery and enhance recreational opportunities. Recreation facilities would be provided at the reservoir and minimum releases would be made at the dam to satisfy fishery requirements. Selection of the Agency site over considered alternatives was based primarily on relative excess of benefits over costs, and the opportunity to satisfy a considerable portion of recreation needs. Buck Hollow Reservoir on Willamina Creek would have a capacity of about 84,000 acre-feet. It would be operated to serve the same functions as Agency. In addition, the relatively deep reservoir could provide some improvement in downstream water temperature. Gopher Valley Reservoir, with a capacity of 33,000 acre-feet, would be located on Deer Creek at the lower end of Gopher Valley. That reservoir would also be operated to serve the multiple-purpose needs of flood control, irrigation, recreation, and reservoir fishery. Specific fish flows have not been recommended on Deer Creek but the planned constant flow of 25 cfs downstream from the dam would be adequate for anadromous fish migration. A local group is considering alternative development of the site under either the PL 566 Program or the Small Reclamation Projects Act. As noted earlier, the reservoir could be constructed under either of those programs and be compatible with a plan of development for the South Yamhill drainage.

(e) Palmer Creek Water District Improvement Company, a private community project, would irrigate about 3,500 acres with natural flows from Willamette River. Application for use of Willamette River natural flow has been made and construction of facilities completed.

(f) Basin-system channel improvement, to permit efficient operation of flood control storage in the Yamhill drainage, would be required on North and South Yamhill and Yamhill Rivers. The work involved would be limited to that essential for flood control operation. It would consist principally of channel stabilization, and possibly some minor channel enlargement and cleanup.

(g) Environmental management of lands along Yamhill River is proposed. Cooperative private and non-Federal public action would be required for implementation.

(5) Fish and Wildlife development would include, in addition to features associated with the previously discussed projects, (a) additional habitat development and public-use facilities at the two wildlife refuges, and (b) acquisition and development of seven mineral springs to enhance pigeon hunting in the area.

(6) Other features include provision of irrigation facilities primarily through private-sector development; additional recreation facilities, both water- and nonwater-related; a local program of flood plain use regulation to complement the effects of structural measures for control of floods; installation of 52 small group enterprise jobs on agricultural land involving channel improvement, dike construction, improved drainage outlets, and irrigation development; and soil and water restoration measures at 7 identified locations on O&C forest lands and 7 locations in National forests.

b. Long-range features. - Although the early-action elements would satisfy a large block of multiple-purpose water resource needs, there would be unmet needs beyond 1980 in addition to projected new demands, especially for flood control, increased recreation facility development and irrigation development.

(1) Marys River. Existing development, and storage and related facilities included in the early-action phase for the Marys River drainage, are expected to satisfy water needs projected to 2020. No major storage developments are recommended for the long-range period.

(2) Luckiamute River. Projected water needs for the Luckiamute River drainage would require additional developments beyond 1980. Two projects which could satisfy the bulk of those needs for the area would be the Soap Creek Watershed Project Extension and Little Luckiamute River Watershed Project Extension.

(3) Rickreall Creek. Projected needs for the Rickreall Creek drainage show that additional water and land resource development would be needed beyond 1980. Expansion of the Monmouth-Dallas irrigation project and construction of the multiple-purpose Dallas Dam and Reservoir would make significant contributions toward meeting the needs.

(a) Monmouth-Dallas Project expansion would bring the project acreage to about 28,000. Water supply for the additional lands, as for the initial project, would come from natural flows in Willamette River.

(b) Dallas Dam and Reservoir, site number 268 on Rickreall Creek, appears to be a desirable element for the long-range phase to serve the functional needs of flood control, recreation, fish and wildlife, and possible municipal and industrial water supplies. Consideration was given to omitting the Dallas Dam and Reservoir from the long-range phase, in accordance with the Recreation Committee's recommendation, to allow Rickreall Creek to be maintained as a scenic stream in a free-flowing state. However, without the Dallas Reservoir, flood damage to existing developments could not be reduced significantly, optimum fish-flow requirements would go unmet, and needed recreation facilities would have to be located elsewhere or the demand channeled to facilities in other subbasins.

(4) Yamhill River. It appears that a considerable portion of the unmet needs beyond the early-action phase in the Yamhill drainage could be met by extension of the Salt Creek and Chehalem Creek projects and development of five additional small reservoir projects.

(5) Watershed projects having the best potential for meeting needs after 1980 are North Yamhill, Benton County, Bowers Slough, Panther Creek, Baker Creek, Willamina Creek, Cosper Creek, Agency Creek, Ash Swale, and Marys River. Current status of land use, development, and water related problems for each of those watersheds are shown in Table A-1, Addendum A to Appendix G.

Principal structural measures involved in those watersheds would be: (a) a 13,000-acre-foot reservoir at site No. 317 on Soap Creek, (b) a 5,500-acre-foot reservoir at site No. 575 on Grant Creek, (c) a 3,600-acre-foot reservoir at site No. 576 on Salt Creek, (d) a 2,600-acre-foot reservoir at site No. 580 on Spring Brook, (e) a 26,700-acre-foot reservoir at site No. 584 on Rowell Creek, (f) a 19,500-acre-foot reservoir at site No. 301 on Panther Creek, (g) a 14,600-acre-foot reservoir at site No. 256 on Baker Creek, (h) an 11,700-acre-foot reservoir at site No. 318 on Tindle Creek, (i) an 11,700-acre-foot reservoir at site No. 585 on Ead Creek, and (j) about 53 miles of

tributary channel improvements.

(6) Other Features. In addition to the proposed multiple-purpose storage projects, other types of development efforts are proposed to meet the projected water and related needs beyond 1980. In Subbasin 6, the bulk of other development elements is associated with needs for recreation, irrigation, and additional basin-system channel improvements.

(a) Basin-system channel improvements would be added to those in the early-action phase as necessary on the basis of experience. It now appears that work, probably principally additional channel stabilization, would be needed on Marys, Luckiamute, Yamhill, North Yamhill, and South Yamhill Rivers.

(b) Irrigation. To meet the projected expansion of irrigation beyond 1980, additional water supplies and facilities would be required to serve a total of about 60,000 acres in the subbasin. About 18,000 acres in the upper West Muddy Creek drainage and between West Muddy Creek and Willamette River could best be served from Long Tom River using existing Federal storage in the Willamette system as a source of supply. In the Luckiamute River drainage, there are about 20,500 acres projected to come under irrigation, of which 7,000 would be served by storage releases from the proposed Pedee Reservoir, and 13,500 acres located in the Adair area by pumping from Willamette River using upstream Federal storage supplies. Three areas in the Yamhill River drainage, totaling about 22,000 irrigable acres, would require water supplies and distribution systems. The most probable source of water supply for those lands would be Federal storage in the Willamette River system, pumped from Willamette River.

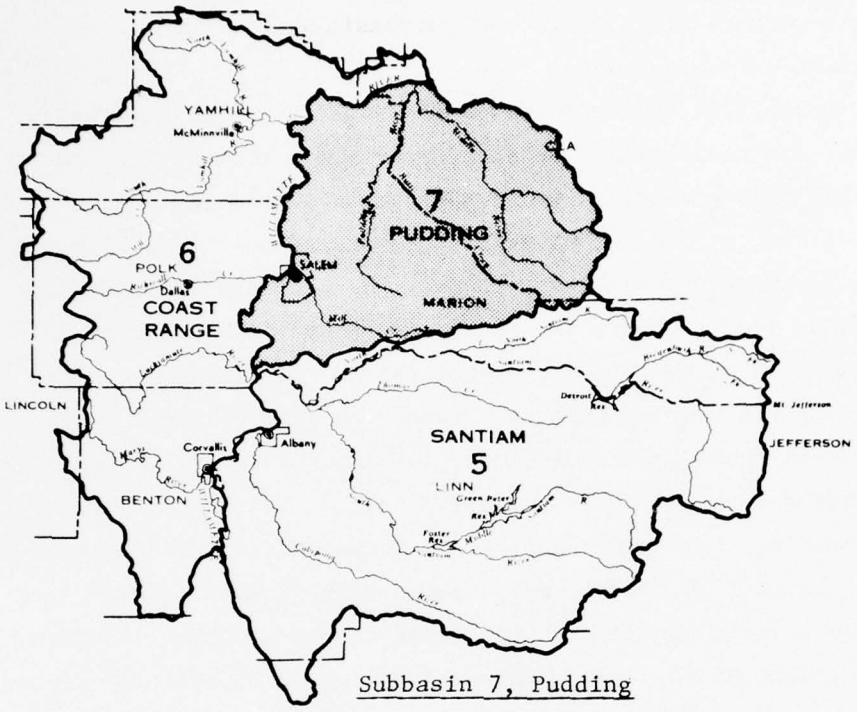
(c) Recreation. Follow-up programs and action in the recreation field should be maintained. In all proposed reservoirs, consideration should be given to providing water specifically for recreation use. Additional facilities should be provided at the reservoirs and along the rivers as the needs arise.

c. Opportunities. - An opportunity exists for storage development at site number 327 on West Fork Marys River. However, the Recreation Committee recommends that Marys River be managed in its natural state under a program for preservation and protection, and the only excep-

tion made was for an early-action reservoir at the Noon site. Therefore, site No. 327 is omitted from the long-range plan to permit the remainder of the stream, upstream from Noon Reservoir, to provide for recreational and environmental needs which cannot be served by reservoir development.

d. Remaining needs. - As shown in Table IV-9, the projects included in the plan would meet nearly all of the identified subbasin needs and provide additional capacity for service in some functional fields. At some points in the subbasin--Marys River at Philomath and North Yamhill River at Pike--available flood control storage space would permit control of floods larger than the 100-year frequency level. Capacity in excess of projected needs would exist in water surface for recreation and fishing, as a result of meeting locational deficiencies in irrigation supply and because of the joint-use aspects of storage planned for other purposes. Tables V-6 through 14 summarize, by functions and generally by subbasins, for the basin as a whole, the remaining needs and additional capacities in excess of projected basin needs.

SUBBASIN 7 - PUDDING



Subbasin 7, Pudding

The Setting

Subbasin 7 consists of the drainage areas of Pudding and Molalla Rivers and all lands between the Pudding drainage and Willamette River from Santiam Subbasin north to Clackamas Subbasin. Molalla River heads in the Western Cascades subunit well to the west of, and at a lower elevation than, the crest of the Cascade Range. Pudding River and its tributaries head to the west of, and lower than, the Molalla; it generally parallels Willamette River. It flows sluggishly, in a meandering channel with little slope, through an area of very rich bottom lands which flood often. Molalla and Pudding Rivers join just before reaching Willamette River.

The subbasin is about equally divided between agricultural and forest lands; it includes the Salem population center, third largest in the basin. Population density is about equal to the basin average. Most of the forest lands are in large private holdings.

All of the needs shown in functional appendixes D through L were considered; the most pressing needs were determined to be those associated with fish and wildlife enhancement, flood control, irrigation,

water quality and recreation. There are no existing, authorized or assured major multiple-purpose projects in the subbasin, and no Federal recreation development on Federal lands.

Molalla River flows are only reasonably well sustained during the summer months, and the flows of Pudding River and tributaries become very low during that period. Water temperatures exceed acceptable levels for cold-water fish in Pudding River, the lower reaches of Molalla River, and the low-elevation tributaries. To meet the projected demands for resident fishery would require new impoundments and fish production programs. Supplies of many wildlife species are insufficient to meet present demands; for many species that condition will continue in the future. Wildlife development needs include acquisition of a pigeon spring and improvements to Ankeny Wildlife Refuge.

Annual flooding occurs on about 28,300 acres in the subbasin. Damages now amount to about $537,000 annually, and studies indicate that flood plain management would not provide an answer to the problem. Storage sites are available in the Molalla River drainage to effectively control floods at Canby. However, storage possibilities in the Pudding River drainage lack the physical capability to effectively control the river, indicating a need for channel improvement measures and a remaining subbasin contribution to downstream flood flows.

Irrigation development using flow from subbasin streams is limited because there is no appreciable unappropriated natural flow. However, there is a considerable amount of water available in North Santiam and Willamette Rivers from existing and authorized Federal reservoirs. In addition, the ground water potential, particularly in the French Prairie area, is expected to sustain several times the present level of use. Some of the potentially irrigable lands, however, are situated away from the ground water areas and existing supplies of stored water. Those lands would require new storage development at several places within the subbasin.

Effective land treatment measures are in use throughout the subbasin. However, maintenance of high soil productivity and minimum erosion losses, and improvement of water quality downstream, would require continued efforts and investments in conservation measures and watershed protection.

Recreation facility capacity in the subbasin would satisfy only about one-fourth of the projected subbasin demands in recreation days. Water-surface capacity for recreational use also fails, by a considerable amount, to meet projected demands. Multiple-purpose storage reservoirs with accompanying facilities, and extensive recreation developments along Willamette River and other streams could satisfy subbasin needs as projected to the year 2020. However, consideration must be given to Recreation Committee recommendations that Molalla River, Butte Creek, and Abiqua Creek be retained in natural condition under an environmental management program.

Present M&I needs are served from surface and ground water sources, which appear adequate to meet future demands. The City of Salem, however, is considering a contract for use of stored water from Detroit Reservoir to augment its supplies in the future; that source would be an alternative to use of Willamette River flows. Silverton is exploring the possibility of obtaining additional supplies from Silver Creek. Most of the other communities rely on ground water, and probably will continue to do so. However, at least some of those communities would have the option of contracting for stored water from suitably located projects, and might choose to do so. Expanded service will require additional facilities, such as increased purification plant capacity for the City of Molalla, and full treatment of Salem's supply from North Santiam River.

The major water quality problem occurs in Pudding River. Extremely low flows and velocities result in high temperatures and generally poor quality each summer. Flow augmentation is needed to provide esthetic desirability and stability.

Subbasin Rationale

Neither a reasonable degree of flood control, nor of service to irrigation, fish and wildlife, recreation, and water quality needs in the subbasin, could be provided without storage. Thus, multiple-purpose storage projects would be the core of the subbasin development. Such projects also could contribute to meeting needs outside the subbasin, both for flood control and flow augmentation.

Almost 80 storage sites in the subbasin were screened, and evaluated as appropriate. Final selection, in subbasin analysis, was based on

physical feasibility, functional capability, and location with respect to needs, both within and outside the subbasin. Potential impact on local, subbasin, and overall basin environment also was considered.

The following discussion shows pertinent rationale and outlines proposed development features. Table IV-10 presents a data summary of water-related needs and anticipated storage project accomplishments as of 2020, in units as used in subbasin analysis.

a. Early-action features. - Early-action features were selected on the basis of capability to meet identified needs, and probable economic justification. Considerable weight was given to the degree of compatibility with existing development, to capability to meet all or a portion of immediate and future subbasin and downstream needs, and to environmental factors.

The early-action features include an allowance for individual and group irrigation development based on use of ground water. Other features include: (1) three small watershed projects; (2) a large multiple-purpose storage development, now under feasibility investigation; (3) modification of an authorized channel project for flood control; (4) a system of channel improvements associated with storage; (5) wildlife improvements; (6) an environmental management program; and (7) extensive recreation development.

(1) Small watershed projects involved are those in the Butte Creek, Drift Creek-Pudding River, and Mill Creek watersheds. Those projects would be developed, in cooperation with local sponsors, to meet watershed needs and satisfy local desires for fish and wildlife, flood control, irrigation, and recreation. In addition, depending on subsequent agency-local decisions, project storage might be used for municipal and industrial water supply and water quality improvement. The three projects include seven multiple-purpose reservoirs with an aggregate capacity of about 65,300 acre-feet and a total surface area of about 2,400 acres. In addition to storage and related facilities, the watershed projects would include provisions to meet associated land treatment needs, 21 miles of channel improvement to meet watershed needs for flood control and drainage, and an irrigation distribution system. Channel improvement would be closely coordinated with fish and wildlife agencies.

Table IV-10

Projected water-related needs and storage accomplishments

Subbasin 7 - Pudding, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments											
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Navigation Flow, cfs	Power Cap. kw	Recreation, 1,000 rec.-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. Projected Subbasin Needs:	-	-	-	-	-	*148*	-	*28*	-	-	*616,000*	*188,000 8/*	*0 4/*	*N/A 6/*	*6,505*	*6,505*	-
1. Molalla R., @ Canby	-	-	-	-	-	-	500	-	75,000 6/	231	-	-	-	-	-	-	-
2. Silver Cr., @ mouth	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-
3. Pudding R., nr. Aurora	-	-	-	-	-	-	80	-	150,000 6/	399	-	-	-	-	-	-	20-160
B. Presently Assured Accomplishments:	*N/A*	-	*N/A*	-	-	*48*	-	*9*	*0*	-	*474,800*	*188,800*	*N/A 4/*	*0*	*6,756 7/*	*0*	-
1. Natural flows and small storage:	N/A	-	N/A	-	-	48	-	9	-	-	104,400	-	-	-	6,756	-	-
Molalla R., @ Canby	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Silver Cr., @ mouth	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
Pudding R., @ mouth	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-
2. Storage reservoirs	-	-	-	-	-	-	-	-	-	-	117,200 8/	-	-	-	-	-	-
3. Groundwater	-	-	-	-	-	-	-	-	-	-	252,900	-	-	-	-	-	-
C. Total Residual Needs:	-	-	-	-	-	*96*	-	*19*	-	-	*148,100*	*0*	*0*	*N/A 6/*	*(+421)*	*6,505*	-
1. Molalla R., @ Canby	-	-	-	-	-	-	500	-	75,000 6/	231	-	-	-	-	-	-	-
2. Silver Cr., @ mouth	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-
3. Pudding R., nr. Aurora	-	-	-	-	-	-	80	-	150,000 6/	399	-	-	-	-	-	-	20-160
D. New Storage Accomplishments:	*464,950*	-	*7,880*	-	-	*784*	*N/A*	-	*9/*	*9/*	*188,000*	-	-	-	*8,081*	*2,846*	-
1. Early-action reservoirs:																	
Beaver Cr., site No. 337	5,700)	1,500	190	-	R,O 10/	24 11/	-	-	12/	-	-	-	-	-	76	76	-
Coal Cr., site No. 586	15,600)		300	-	I	-	-	-	12/	-	15,600	-	-	-	-	-	-
Drift Cr., site No. 410	9,000)	2,900	310	-	I,O 10/	-	-	-	12/	-)	6,000	-	-	-	-	-	-
S. Fk. Pudding R., site No. 350	5,200)		260	-	I,R,O 10/	32 11/	-	-	12/	-)		-	-	-	130	100	-
Beaver Cr., site No. 407	21,200)		1,000	-	FC,R	125 11/	-	-	5,600	21	-	-	-	-	500)		-
Mill Cr., site No. 367	5,950)	4,150	250	-	FC,O 10/	-	-	-	12/	-	-	-	-	-	-)	500	-
Battle Cr., site No. 358	2,700)		100	-	R,O 10/	12 11/	-	-	12/	-	-	-	-	-	50)		-
Dickey Bridge, site No. 348	273,000	-	2,650	-	FC,I,R,F&W	331 11/	500	-	165,000	204	49,000	-	-	-	1,175	1,175	-
Grange, site No. 352	80,000	-	680	-	FC,I,R,F&W	85 11/	60	-	34,000	40	49,000	-	-	-	275	275)	20-141
Selah, site No. 386	22,000	-	1,400	-	FC,I,R,F&W	175 11/	-	-	20,000	59	6,000	-	-	-	620	620)	
Subtotals	440,350	-	7,140	-	-	784	N/A	-	-	-	155,600	-	-	-	2,826	2,746	-
2. Long-range reservoir:																	
S. Fk. Silver Cr., site No. 593	24,600	-	510	-	R,FC,O 10/	-	-	-	12/	-	-	-	-	-	255	100	-
E. Year 2020 Conditions:																	
1. Subbasin storage totals	*464,950*	-	*7,880*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Unmet needs:	-	-	-	-	-	-	*N/A*	*19 13/*	-	-	*0*	*0*	-	*N/A 5/*	*0*	*3,419 14/*	-
Pudding R., nr. Aurora	-	-	-	-	-	-	-	-	*109,000 6/*	*300*	-	-	-	-	-	-	*19*
Molalla R., @ Canby	-	-	-	-	-	-	-	-	-	*57*	-	-	-	-	-	-	-
3. Additional capacity:	-	-	-	-	-	*889 15/*	-	-	-	-	*28,800 16/*	-	-	-	*3,673*	-	-
Molalla R., @ Canby	-	-	-	-	-	-	-	-	*65,000*	-	-	-	-	-	-	-	-

N/A Not available for subbasin or location.

1/ Additional data are shown in Part V.
2/ Additional study to be made; see Part V.
3/ Includes municipal requirement for Salem area.
4/ No need in subbasin; storage releases contribute to meeting Willamette River needs.
5/ Projections available only on a total-basin basis.
6/ Effective, at station shown, for control of a 100-year flood.
7/ Includes Willamette River.
8/ From existing storage in Detroit Reservoir, N. Santiam River.
9/ Year 2020 figures show effect of accomplishments.
10/ Space not fully assigned, some available for other purposes.
11/ Capacity based on 138 fish per surface acre; management practices discussed in Appendix D required for utilization of potential
12/ Incidental to filling for other purposes listed.
13/ Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.
14/ Can be met by implementation of programs presented in Appendix K, Recreation, and Pudding River channel project.
15/ At present angler success ratio, additional fish would be used, to the extent available.
16/ To be supplied to a 4,800-acre area in Subbasin 8.

Project facilities would reduce the average annual flood plain by about 1,460 acres, and provide an irrigation water supply for roughly 7,500 acres. Provision would be made for initial recreation use estimated to be in the order of 275,000 visitor-days annually. Project reservoirs include about 8,500 acre-feet of storage space which could be used to satisfy about 15 percent of the summer low-flow requirement at Aurora on Pudding River. Specific assignments, or sizing changes as appropriate, will be made in further studies in cooperation with project sponsors and concerned agencies. Consideration will be given to making fish and wildlife a project function.

(2) Molalla Project would serve substantial additional multiple-purpose water needs projected for the subbasin which are beyond the capability of private-sector and small-watershed developments because of the magnitude of investment required. Those needs are principally for irrigation and flood control. A significant portion of the remaining irrigation needs could be met by diverting into the subbasin water stored in an existing Federal reservoir in North Santiam drainage. That service would not contribute toward alleviating flood control needs nor could it completely satisfy the irrigation needs. Therefore, additional storage reservoirs within the subbasin are considered essential elements in affecting water resource control and use.

A plan was formulated taking into consideration location and magnitude of water needs, physical and economic parameters of potential reservoir sites, and recommendations for preservation of natural environment. Of the five principal subbasin streams, all but Pudding River and Silver Creek were recommended for inclusion in the proposed preservation program. Storage reservoirs selected on the basis of screening studies consist of Selah on Pudding River, Grange on Silver Creek, and Dickey Bridge on Molalla River. Selah and Grange alone could not physically provide the needed water supply. Therefore, storage would be required on at least one of the remaining three streams, Molalla River and Butte and Abiqua Creeks. Dickey Bridge site appears to be the most favorable on Molalla River from geologic and cost standpoints. Further, it would have considerably the greatest capability in meeting water supply and flood control needs both in the subbasin and downstream on Willamette River.

Several combinations of reservoir sizes were evaluated to determine the approximate combination which would maximize net benefits. Reservoir operation studies and reconnaisance cost estimates provided the basis for incremental analysis and scoping of reservoir sizes. Based on those studies, the three reservoirs would provide in the order of 375,000 acre-feet of total storage capacity, with a total surface area of about 4,700 acres. Preliminary studies indicate that power generation would not be economically justifiable at any of the three sites.

Dickey Bridge and Grange Reservoirs would be capable of controlling a 100-year flood at the respective sites; Selah would provide about one-half the storage required for flood control purposes.

Storage and facilities would be provided to serve the irrigation needs of about 55,000 acres, of which about 5,500 are in the adjoining Clackamas Subbasin. In addition, stored water available in North Santiam River would be diverted to serve about 45,000 acres east of Salem, for which no economical supply is available in the subbasin.

All three reservoirs would create water-based recreation opportunities, and facilities would be provided to use the potentials afforded by storage project lands and water area. There would be no interference with the Silver Falls Recreational Area on Silver Creek.

Preliminary operation studies indicate that flows required for water quality purposes, other than fish and wildlife, in Pudding River could be met during most years through 2020. The flow would be made up of natural flows and fishery releases at Grange and Selah.

(3) Authorized channel improvement for Pudding River would be modified to include development of recreation potential. Principal elements of the improvement work would be 28 miles of channel clearing and excavation, on Pudding River, and a total of 11 miles of similar improvement on Pudding River tributaries. Close coordination of detailed planning with fish and wildlife and recreation agencies would be essential.

(4) Basin-system channel improvement required for operation of major subbasin reservoirs for flood control would be limited to channel stabilization on Molalla River. Neither the degree of control

proposed for Pudding River and Silver Creek nor the slope and flow characteristics of those streams indicate a need for either channel enlargement or stabilization works. On Molalla River, however, slopes are relatively steep, channels are unstable, and a relatively large amount of storage is involved.

(5) Wildlife improvements would consist of acquisition and development of a mineral spring near St. Paul to enhance pigeon habitat and provide improved hunting opportunity in the area. Also, improvements should be provided for the Ankeny Wildlife Refuge. The needs include additional land, roads, dikes, display pool, and picnic and parking area developments.

(6) Recreation development, in addition to the facilities and water-surface area associated with the proposed reservoirs, would be provided. Features include extensive recreation development along Willamette River and subbasin streams. Such activities should include continued action on the Willamette Parkway system, Federal and State assistance to encourage private development, and cooperative programs between Federal agencies and private landowners.

(7) Other features consist principally of: (a) a local program of flood plain use regulation; (b) the proposed environmental management program for Molalla River, with the exception of the Dickey Bridge site and basin-system channel improvements, and for Butte and Abiqua Creeks; (c) installation of 21 small group enterprise jobs on agricultural land involving channel improvement, improved drainage outlets, and irrigation development; and (d) soil and water restoration measures at 10 identified locations on O&C lands.

b. Long-range features. - Beyond 1980, there are identified subbasin needs for additional reduction of flood flows in Pudding River, for additional channel stabilization on Molalla River, for improvement of additional tributary channels, and for additional recreation development. In addition to those in the subbasin, there would be remaining downstream needs for flood stage reduction, and possibly for additional flow augmentation. Further, the level of sport fishing and hunting demand and use is a function of the abundance of supply as well as of number of participants. Thus, the need for enhancement of fish and wildlife potentials would continue to exist, in the subbasin and downstream.

In consideration of those factors, the long-range features for the subbasin include: (1) a multiple-purpose reservoir on South Fork Silver Creek under the small watershed program, or possibly by the State; (2) additional channel stabilization on Molalla River; (3) about 28 miles of channel improvement on small tributaries; and (4) additional separate recreation development, both on Pudding River and as a part of the Willamette Parkway system.

The South Fork Silver Creek storage project would be entirely within Silver Falls State Park. It would provide storage for flood control on that stream and along Pudding River; and stored water for recreational use, a reservoir fishery, and downstream uses. Before it could be constructed and used, an existing legislative withdrawal of the waters of South Fork Silver Creek would have to be amended to permit storage for the purposes known, or foreseen, to be needed.

The nature and extent of additional recreation development will require analyses during the long-range period. Current indications are that additional access to and facilities on streams with flows of good quality water would be involved.

Watershed projects with the best opportunities for meeting needs after 1980 are Champoeg Creek, Lower Pudding, Rock Creek, Gribble Creek, Zollner Creek, Abiqua Creek, and Silver Creek. Current status of land use, development, and water-related problems for each of these watersheds are shown in Table A-1 of Addendum A to Appendix G. Principal structural measures involved in these watersheds would be the previously mentioned South Fork Silver Creek reservoir and tributary channel improvements.

c. Opportunities for possible future development consist principally of other storage sites. Such sites have physical, and as yet undefined economic, potential for future use under changed conditions. One site in this category, Coal Creek on Butte Creek, appears to be the most promising and could provide a measure of flood control benefits. However, it was omitted form the long-range plan in favor of including that stream in the environmental management program.

d. Remaining needs. - As shown on Table IV-10, the storage projects discussed would provide apparent subbasin surpluses of service in some functional fields, and leave remaining needs in others. The surpluses would be in acre-feet of storage available for control of a

100-year flood on Molalla River, and in water area capacity for recreation for the subbasin. The principal remaining needs would be for more flood control storage in the Pudding River drainage, for increased flows of good quality water in Pudding River, and for control of flood runoff from a larger portion of the Molalla River drainage area.

The apparent surplus of flood control storage would provide capacity for at-site control of floods larger than the 100-year-frequency level, and would contribute to flood stage reduction downstream. Thus, when viewed from a basin-wide-needs standpoint, there would be no surplus. Tables V-6 through 14 summarize, by functions and generally for each subbasin, the remaining total basin needs and additional capacities for service in excess of projected basin needs.

SUBBASIN 8 - TUALATIN



Subbasin 8, Tualatin

The Setting

Subbasin 8, Tualatin, consists of the drainage basin of Tualatin River. About one-half of the subbasin area is forest land and about four-tenths is devoted to agriculture. Almost all forest lands are in private ownership. Subbasin population density is about 1.6 times the basin average and projected to increase more rapidly than the average because of proximity to the Portland metropolitan area.

The area consists of a central plain ranging in elevation from about 100 to 300 feet, mean sea level, surrounded by hills or mountains that rise to higher elevations. Topography of the upper reaches of the main stream and tributaries is characterized by narrow valleys and steep ridges. Slopes of the streams are quite steep. As the streams emerge from the foothills, the abutting topography changes rather abruptly to comparatively flat valleys with fairly wide flood plains.

Tualatin River and tributaries meander across the valley floor in a wide alluvial flood plain. Streambanks have been built up by deposition and in many places are higher than the adjoining lands. At the lower end of the valley floor, the flood plain narrows to less than one-fourth mile in width.

The farm economy of the subbasin is based primarily on the production of hay and pasture crops, dairy products, small grains, and specialty crops. There are canneries, quick-freeze plants, and nut-processing establishments to handle the farm commodities now produced in the area. Dairying is one of the major sources of farm income.

Hillsboro and Forest Grove are commercial centers within the main agricultural area. The city of Portland provides a large and dependable market for agricultural commodities, as well as having processing facilities for farm produce. Timber once was a major resource in the area, but most of the virgin stands of Douglas-fir have been cut. The sawmills in the subbasin utilize logs obtained primarily from the west slope of the Coast Range or from other points outside the subbasin.

Population in Tualatin Subbasin is growing at a rapid rate and is expected to continue into the future. During the 1950-to-1960 period, population in Tualatin Subbasin increased 55 percent, the largest increase of any subbasin in the Willamette. Residential and industrial development is expected to encroach on the agricultural land area and limit irrigation development, particularly after 2000. This burgeoning population is creating needs in all functional fields of water resource development.

The most limiting factor in fishery production is low, warm streamflow in the summer. Dissolved oxygen content below acceptable standards is common in lower Tualatin River during low-flow periods. Summer temperatures in the higher elevation streams range from 55°to 75°F. Temperatures as high as 75°to 80°F. are typical throughout Tualatin River during the summer. Increased pollution, coupled with deteriorated water quality, could destroy the present and potential fishery.

Supplies of most wildlife species are insufficient to meet present basin-wide demands and for some will continue so in the future. The outlook for meeting big game and waterfowl needs is extremely poor.

The low-water profile of Tualatin River has a zero slope for about 30 miles upstream from a private diversion dam near the mouth. Thus, there are substantial flood and drainage problems on much of the valley floor. Annual flooding occurs on about 15,500 acres in the subbasin. Without additional flood control measures, flood damages by 2020 are expected to increase by about two and one-half times. Because of the

subbasin topography, the flooding and drainage problems cannot be solved effectively by storage development alone. A major improvement to the channel, however, would both alleviate flooding and drainage problems and make storage developments more effective for flood control. Land measures and watershed projects are also needed, and would be compatible with major channel improvement.

Irrigation land and water needs are expected to increase rapidly through the year 2000, then decline slowly as urban and industrial expansion replaces agriculture use. To meet the water demands for some 55,000 additional acres expected to come under irrigation by 2000, will require about five times the water now diverted. Ground water supplies are limited in this subbasin and Willamette River is too distant to economically serve the lands. Some farm pond development is expected, but the most likely and abundant source of water for irrigation will be storage reservoirs within the subbasin. With the projected decline in irrigation after the year 2000, there would be an increasingly large block of water available for other uses, such as municipal and industrial supplies, increased reservoir recreation and resident fishery, or increased flows in Tualatin River.

Communities in the Tualatin Subbasin have become very water conscious, having experienced shortages and having lost industries for lack of water. The western urban and suburban areas are very near a water shortage each year; the situation annually varies from apprehensive to critical, depending on the weather. The central areas also run short of water but do not have seasonal industrial water demands that must be met. In the eastern area, the situation largely hinges on the ability of the City of Portland to provide water; so long as that source remains available to meet additional needs, there will be no shortage. However, well levels fall each year, the cost of water purchased from Portland and its refusal to enter into long-term contracts with guaranteed flows indicate to many people that other sources deserve serious consideration.

Authorized and assured Federal projects are presently planned to provide M&I water from storage. Scoggins Reservoir will provide 14,000 acre-feet annually and McKay-Rock Creek project reservoirs an additional 13,500 acre-feet. Hillsboro is developing an out-of-basin water source and Forest Grove may participate. The source involved is the North Fork

of Trask River. About 4,000 acre-feet of storage is proposed and there is a possibility for increasing to 20,000 acre-feet in the future.

Although available only in limited quantities in the subbasin, ground water is expected to continue to supply farm units and other rural dwellings requiring small quantities of water. In parts of the western end of the subbasin, however, ground water is inadequate even for rural needs.

The capacity of existing recreation facilities is extremely deficient in terms of meeting current as well as future needs. In addition, there is no water surface area available for public use within the subbasin, except for some sections of Willamette and Tualatin Rivers. Three multiple-purpose Federal reservoirs--the authorized Scoggins and recommended McKay and Rock Creek--will make substantial contributions in both water surface area and recreation facilities. However, additional water surface area and facilities will be required to meet future needs. Provision of additional facilities on the streams, particularly along Tualatin River, would make a sizeable step toward satisfying the recreation facilities requirements.

Water quality is poor in Tualatin River and most of its tributaries in the urbanized portion of the subbasin. Municipal and industrial wastes discharged from 20 treatment plants to Tualatin River and its tributaries receive more than 85-percent BOD removal, and disinfection. Also, Washington County has adopted a Master Plan for sewerage and sewage disposal which, when implemented, will go far toward improving water quality in Tualatin River. However, even with a higher degree of treatment, additional flows would be required to meet dissolved oxygen requirements in Tualatin River.

Subbasin Rationale

Because of the high population density, proximity to the basin's major population center, and the relative lack of water resource development, there is a substantial need for multiple-purpose water and land resource development. The functional water and related land resource requirements of Tualatin Subbasin reflect a real need for improved water supplies for a variety of uses, as well as for facilities for water control, use, and distribution.

There are no major existing water resource developments in Subbasin 8. For formulation purposes, however, the authorized multiple-purpose Tualatin Project, and the assured McKay-Rock Creek Watershed Project were considered as features of a base system.

The following discussion describes the proposed measures and accompanying rationale for selection. Table IV-11 presents a statistical summary of the major water-related needs, proposed reservoirs, and anticipated storage accomplishments in the subbasin as of 2020.

a. Early-action features. - Proposals for early action include one large multiple-purpose project involving two reservoirs; two small watershed projects, one of which might be developed in lieu of the multiple-purpose project; and one channel improvement project.

(1) Tualatin Project, 2nd Phase, with two reservoirs--Gaston, at site No. 422 on Tualatin River and East Fork Dairy Creek, at site No. 417 on the stream of the same name--would serve a large block of the multiple-purpose water needs in Tualatin Subbasin.

(a) Gaston Reservoir, with a capacity of 68,000 acre-feet, would be operated to provide an irrigation water supply for about 15,000 acres, 20,000 acre-feet of water for M&I purposes, specific storage of 25,000 acre-feet for water quality control, and incidental flood protection. Storage releases to Tualatin River are planned to fully satisfy the water quality needs of year 2020, and would be considerably in excess of fish and recreation requirements.

(b) East Fork Dairy Creek Reservoir, with a capacity of about 47,000 acre-feet would provide an irrigation water supply for about 15,000 acres, and incidental flood protection. A dead or inactive pool of 8,000 acre-feet would be provided for maintenance of a reservoir fishery and recreation purposes. Optimum fish flows downstream from the dam would be equalled or exceeded for most of the year largely as a result of irrigation releases. Adequate land areas would be provided, and associated recreation facilities would be developed, around both reservoirs to accommodate an estimated initial annual visitation of 245,000 recreation-days. The reservoir would be relatively shallow and would not be expected to appreciably enhance the temperature of the streams.

Table IV-11
Projected water-related needs and storage accomplishments
Subbasin 6 - Tualatin, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments										
	Capacity, ac.-ft.		Pull Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Navigation Flow, cfs	Power Cap., kw	Recreation 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous Flow, cfs	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. *Projected Subbasin Needs:*	-	-	-	-	-	193	-	168	294,000 3/	571	188,400	168,000 4/	0 5/	N/A 6/	5,718	5,718	270 7/
1. Tualatin R. @ mouth	-	-	-	-	-	-	30	-	294,000	571	-	-	-	-	-	-	270
2. E. Fk. Dairy Cr. @ mouth	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-
B. *Presently Assured Accomplishments:*	81,700	-	3,183	-	-	41	6/	55	12,700 3/	44	105,800	82,000	N/A 6/	0	4,684 8/	1,680	106
1. Natural flow and small storage	N/A	-	N/A	-	-	41	-	55	-	-	44,500)		-	-)		-)	
2. Storage reservoirs:											)			)		)	
Scoggins (auth.)	59,200	-	1,113	FC,I,R,WS,WQ,F&W	-	N/A	-	-	11/	-	39,100)	82,000	-	-)	4,234	500)	106 10/
McKay Cr. (assured)	21,500	-	310	FC,I,WS,R	-	N/A	-	-)	12,700	44	10,000)		-	-)		150)	
Rock Cr. (assured)	11,000	-	700	FC,I,R	-	N/A	-	-)			3,300)		-	-)		1,000)	
3. Ground water	-	-	-	-	-	-	-	-	-	-	9,000)		-	-	-	-	-
C. *Residual Needs:*	-	-	-	-	-	80	-	110	281,300 3/	527	80,600	81,000	0	N/A 6/	1,484	4,068	164
1. Tualatin R. @ mouth	-	-	-	-	-	-	30	-	281,300	527	-	-	-	-	-	-	164
2. E. Fk. Dairy Cr. @ mouth	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-
D. *New Storage Accomplishments:* 11/	168,200	-	3,480	-	-	488	6/	-	4,400	23	85,800	20,000	-	-	855	855	164
1. Early-action reservoirs:												20,000	-	-	455	455	164
Gaston, site No. 422	68,000	-	1,720	-	FC,I,R,WS,F&W,WQ	215 13/	30	-	11/	-)	75,000	-	-	-	410	410	-
E. Fk. Dairy, site No. 417	47,000	-	1,030	-	FC,I,R,F&W	258 13/	50	-	11/	-)		-	-	-	185	150	-
Bledsoe Cr., site No. 438)14/	6,000)	5,500	370	-	R,O 15/	46 13/	-	-	11/	-)	6,300	-	-	-	-	-	-
E. Fk. Dairy, site No. 440)	10,000)		180	-	I,O 15/	-	-	-	11/	-)		-	-	-	-	-	-
Trib. W. Fk. Dairy, site No. 449	8,100	-	170	-	I,O 15/	-	-	-	11/	-)	7,500	-	-	-	60	60	-
Tolke Canyon, site No. 435	6,100	-	120	-	I,R	15 13/	-	-	11/	-)	82,500	20,000			925	925	-
Subtotals 12/	134,200	-	3,040	-		488 13/											
2. Long-range reservoirs:																	
Gales Cr., site No. 441	14,500	-	240	-	FC,O 15/	-	-	-	4,400	14	-	-	-	-	-	-	-
McFee Cr., site No. 443	12,500	-	210	-	FC,O 15/	-	-	-	3,000	9	-	-	-	-	-	-	-
Subtotals	27,000	-	450	-	-	-	-	-	7,400	23	-	-	-	-	-	-	-
E. *Year 2020 Conditions:*																	
1. Subbasin storage totals 12/	347,900	-	6,618	-	-	-	0	110 16/	276,900 3/	804	0	61,000 4/	-	N/A 6/	889	3,148 17/	0
2. Unmet needs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. Additional capacity	-	-	-	-	-	408 18/	-	-	-	-	-	-	-	-	-	-	-

N/A *Not available for subbasin or location.*

1/ *Additional data are shown in Part V.*
2/ *Additional study to be made; see Part V.*
3/ *Amount, effective at West Linn, for control of a 100-year flood.*
4/ *Includes rural domestic needs plus subbasin municipal requirements identified with the Portland service area.*
5/ *No need in subbasin; storage releases contribute to meeting Willamette River needs.*
6/ *Projections available only on a total-basin basis.*
7/ *Requirement for July.*
8/ *Residual needs and year 2020 figures show effect of accomplishments.*
9/ *Includes Willamette River.*
10/ *For Tualatin River at mouth.*
11/ *Incidental to filling for purposes listed.*
12/ *Using S. Fk. Dairy Creek as in Tualatin, 3d phase.*
13/ *Capacity based on 100 fish per surface acre; management practices discussed in Appendix D required for utilization of potential.*
14/ *Watershed project storage, alternative to downstream site No. 417 to provide 47,000 acre-feet as a part of Tualatin, 3d phase, multiple-purpose project.*
15/ *Space not fully assigned; some available for other purposes.*
16/ *Can be met by implementation of screen and management programs discussed in Appendix D, Fish and Wildlife.*
17/ *Can be met by implementation of programs presented in Appendix K, Recreation, and Tualatin River channel project.*
18/ *At present angler success ratio; additional fish could be used, to the extent available.*

(2) East Fork Dairy Creek Watershed Project would include two reservoirs, at sites No. 438 and 440, with a combined capacity of 18,000 acre-feet; an irrigation distribution system to serve 2,500 acres; about 6 miles of channel improvement; and recreation facilities to serve an initial use estimated at 60,000 visitor-days annually. Also included is about 5,500 acre-feet of storage capacity which could be used to satisfy 8 percent of the summer low-flow requirement for Tualatin River near West Linn. Further studies would be required to determine the needs for that or other purposes, such as municipal and industrial water supply, or fish and wildlife enhancement.

As indicated above, both Tualatin 2nd Phase and East Fork Dairy Creek Watershed Projects are named for early action. However, because of the overlapping functional accomplishments and reservoir site conflicts, it is unlikely that both would be implemented. The agencies involved will have to cooperate with local interests in reaching a decision in that regard. If local need and justification for both are found, future studies would be required to determine an appropriate scope and plan of operation for each.

(3) West Fork Dairy Creek Watershed Project would be a multiple-purpose development to satisfy a variety of local needs that could not be served by other elements in the plan. Principal features of the project are two reservoirs, with a combined storage capacity of 14,200 acre-feet and combined surface area of 290 acres; 6 miles of channel improvement, an irrigation distribution system to serve about 3,000 acres; and appropriate land-treatment measures. A reservoir, at site No. 449, on a tributary to West Fork Dairy Creek, would be operated primarily for irrigation; a reservoir at site No. 435, on Witcher Creek, would be basically a dual purpose recreation and irrigation development. Recreation facilities are planned at the second site to accommodate an initial annual use of 40,000 recreation-days.

(4) Tualatin River Channel Improvement would make a contribution toward satisfying the needs for flood protection, environmental preservation, and recreation enhancement along Tualatin River. The basic flood control would involve straightening and enlarging the present stream channel, as necessary, deepening the lower end of the channel, and replacement of the old Oregon Iron and Steel Company Dam. That work

would be planned in consideration of environmental and recreational potentials and resources. Recreation, preservation of natural environment, and provision of fisherman access would require a variety of measures including development of several oxbow lakes and adjacent lands for recreation and open space, new recreational facilities, improved access to the river and recreation areas, and general landscaping improvement to maintain the fish and wildlife habitat and esthetics and compensate for any damage occasioned by construction.

(5) Other features would include private-sector provision of irrigation facilities, utilizing primarily ground water; a local program of flood plain use regulation to complement proposed flood control measures; and additional recreation facilities to complement and supplement the recreational opportunities of the subbasin. Specific recreational programs would include: (a) expansion of private-sector development; (b) development of scenic drives; (c) intensified efforts by the communities to provide urban parks and recreation areas; (d) preservation and development of Lee Falls on upper Tualatin River as one aspect of a proposed environmental management program for Tualatin River; and (e) installation of 23 small group enterprise jobs on agricultural lands involving channel improvement, construction, improved drainage outlets, and development of irrigation facilities. Also, there should be continuation and appropriate updating of the County-adopted flood plain use regulation program.

b. Long-range features. - Beyond the early-action period, the principal needs will be for some additional multiple-purpose storage development, channel improvement, and recreation facilities.

(1) Two small reservoir projects, one located on Gales Creek and one on McFee Creek, are included in the long-range plan. Those reservoirs would have an aggregate storage capacity of about 27,000 acre-feet and a water-surface area of about 450 acres. Both reservoirs would be operated for flood control and for other, as-yet-undetermined purposes. Watershed projects having the best potential for meeting needs after 1980 are Gales Creek, Fanno Creek, Baker Creek, and Chicken Creek. Current status of land use, development, and water-related problems for each of those watersheds are shown on Table A-1 of Addendum A to Appendix G.

(2) Other features would be continuation of flood prevention measures and recreation programs which were implemented during the early-action period. Specific features include channel improvement on about 38 miles of small streams, and provision of additional recreation facilities--both water and nonwater-related.

c. Opportunities. - Two storage sites have been identified on Gales Creek--Glenwood site No. 423, and Gales Creek site No. 420. The Glenwood site has a high potential for water supply purposes but, because of steep topography, would not be desirable for recreational use. The Gales Creek site, which is downstream from Glenwood, appears favorable for water supply and recreational uses, but development would block fish runs on the stream. Both sites represent a potential to satisfy some subbasin and possibly basin needs if such arise in the future.

d. Remaining needs. - As shown in Table IV-11, the projects discussed in the preceding paragraphs would meet, so far as the subbasin is concerned, needs in all but four functional fields. The major unmet need would be in the field of flood control, largely because inclusion of storage facilities for flood control could not be economically justified in the early-action reservoirs. However, the reservoirs would provide some flood protection incidental to operation for other purposes, and the Tualatin Channel project would contain floods with a recurrence frequency in the order of once in 10 years. Nevertheless, a sizable unmet need would remain for which the only practical solution would be flood plain use regulation and management. Municipal and industrial water supply needs also would remain after effects of subbasin projects are measured. Those needs could be supplied by importation of water from the adjacent out-of-basin Trask and Wilson River systems and from other Portland service area sources outside of Tualatin Subbasin. A study by the Columbia Region Association of Governments, representing local governments in Clackamas, Multnomah, and Washington Counties in Willamette Basin, contains additional data on water supply needs and potentials.

Tables V-6 through 14 summarize, by functions, projected needs and identified water-related accomplishments, generally for subbasin elements, for the plan as a whole.

SUBBASIN 9 - CLACKAMAS



Subbasin 9, Clackamas

The Setting

Subbasin 9, Clackamas, consists of the drainage area of Clackamas River plus lands along the east side of Willamette River from the mouth of Molalla River to the mouth of Clackamas River. It lies the farthest downstream of any subbasin which drains to Willamette River. The drainage heads at the crest of the Cascades and drains rapidly to Willamette River. Clackamas River has well-sustained low-water flows of good quality and contributes about one-tenth of the average annual runoff of Willamette River. It is used as a source of municipal and industrial supply for a considerable and rapidly growing population. The subbasin has moderate-to-large ground water resources, generally at depths of 100 feet or more, in the agricultural areas. Population density average is about one-third of that for the basin and is concentrated near Willamette River in the Portland metropolitan area. About 85 percent of the subbasin is forested and about 12 percent is devoted to agriculture. Agricultural lands are limited to the western end of the area, and are rapidly being converted to residential use. Access to forest lands, over improved and logging roads, generally is good. The economy of the

subbasin is based principally on forests and forest products, agriculture, and recreation. The metropolitan area at the northwestern end contains industry; commerce; major land and water transportation routes; and Federal, State, and County offices.

Although there has been no Federal storage constructed in the subbasin, there has been considerable private development of hydroelectric power projects. Recreation potentials are large but, because of the proximity of Portland, demand for water-related activities exceeds water surface and facility supply. A particular need exists for development of day-use and group-camp facilities, especially for youth-oriented activity, close to Portland, for sightseeing loop roads, and for preservation of roadside and streamside beauty.

Substantially all of the streams of the subbasin are used by resident and anadromous cold-water fish; resident warm-water fish are almost nonexistent in the subbasin. Studies indicate that, for the basin as a whole, sizable unsatisfied demands for all species of fish will continue up to and beyond 2020. Clackamas River and tributaries have a considerable potential for meeting the needs for cold-water fish. It appears that there is a need for action to avoid loss of anadromous fish habitat and for measures to enhance the cold-water fish population and maintain or increase access thereto.

For the entire basin, future supply of hunting opportunities is expected to be less than demand. With the proximity of the Portland metropolitan area, there will be a pressing need for wildlife habitat preservation and implementation of all practical wildlife enhancement programs. One such program is the acquisition and development of mineral springs to increase pigeon population and improve hunting opportunities.

There is no flood control storage in the subbasin and operation of existing power storage provides only limited or no incidental flood stage reductions. Existing small levee and channel stabilization projects provide protection only in specific small project areas. Based on present flooding conditions and resulting damages, there is an obvious need for both structural and nonstructural flood control measures. The prospect for storage development is not particularly promising; further, the amount that could be developed would not provide an optimum degree of

control. Other measures such as levees and channel improvements, supplemented by effective flood plain use regulation programs will be needed.

Although endowed with an abundant supply of water and a sizable area of potentially irrigable land, Clackamas Subbasin is not expected to realize any substantial expansion of irrigation development. The major deterrent will be a progressive reduction in the irrigable land base, with some 65 percent of the lands now suitable for irrigation being used for urban development. Projections indicate that irrigated lands will increse from 6,300 acres in 1965 to about 25,000 acres in 2020. Most of that additional development would use natural flows, farm ponds, and ground water. The remainder, about 5,500 acres, is expected to utilized proposed new early-action storage in Pudding Subbasin.

Municipal and industrial water supply needs which must be considered include those of the City of Estacada, the community of Boring, rural-domestic users, and the Portland service area, which includes the lower portion of the subbasin. Present sources for those areas outside of the service area are considered generally adequate, and relatively little additional storage will be required to meet needs during the early-action period.

Although the subbasin now has private power installations totaling more than 140,000 kilowatts, and has potentials for additional development, it will continue to be served largely by power generated elsewhere in the region. Thus, in and within transmission distance from the subbasin, there exists a need for any justifiable power development.

The recreation needs being and to be served in Clackamas Subbasin include those of the subbasin plus adjoining areas, particularly the Portland metropolitan area. Development of the recreation resource has somewhat lagged behind the demand, especially in regard to facilities and access. There is a sizable total water surface area in lakes, reservoirs, and on the streams, yet there will be a need to develop additional areas to satisfy future demands. Primary needs in the realm of recreation are for additional water surface areas with appropriate facilities, and additional facilities and improved access on existing sites. In order to meet those needs, the Forest Service, Portland General Electric Company (PGE), and the private sector should be encouraged to increase their efforts in the realm of recreation. In particular,

additional private recreation development is needed in the lower part of the subbasin, and development by PGE and the Forest Service is needed in the upper part. The Forest Service should investigate the possibility of a cooperative venture with PGE to provide additional facilities.

Clackamas River flows are generally well sustained and of acceptable quality. Waste loads on the stream are minor and storage to augment streamflows for water quality purposes does not appear warranted.

Subbasin Rationale

Potentials considered in formulation include the subbasin's primary assets: land, water, project sites, a still-desirable natural environment, and a high recreational potential. Because of the almost-untouched development potential, the principal formulation problems are those of economic feasibility and those of making decisions as to development versus preservation of natural environment.

The following discussion describes subbasin rationale and the resulting subbasin plan. Table IV-12 presents a statistical summary of the water-related needs, proposed storage reservoirs, and anticipated accomplishments of those reservoirs.

a. Early-action features. - No major project developments are proposed in the early-action phase for Clackamas Subbasin. The available potential developments of that sort lack economic justification under present conditions. There is, however, a small group enterprise job which would be installed to provide improved drainage outlets.

Other elements that should be undertaken include provision of channel stabilization, recreation, wildlife, irrigation facilities, and soil and water restoration measures on forest lands. A local program of flood-plain-use regulation should be implemented to reduce or prevent further increases in flood-damage potentials. Additional nonproject-associated recreational facilities should be provided along the subbasin streams and Willamette River. Adequate and dependable access to both water- and nonwater-related recreation sites should be provided to accommodate additional users. An environmental management program is proposed for Clackamas River, Collawash River, and Eagle Creek. Two mineral springs used by band-tailed pigeons should be acquired and developed to meet identified wildlife needs. Additional facilities will be required for

Table IV-12
Projected water-related needs and storage accomplishments
Subbasin 8 - Clackamas, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments											
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Naviga-tion Flow, cfs	Power Cap., kw	Recreation, 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anad-romous, Flow, cfs	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. Projected Subbasin Needs	-	-	-	-	-	*934*	*880 3/*	-	*305,000 3/*	*764*	*68,100*	*48,000 4/*	*0 5/*	*N/A 6/*	*4,882*	*4,882*	*N/A*
B. Presently Assured Accomplishments:	*57,700*	-	*N/A*	-	-	*314*	*680*	-	*0*	-	*54,600*	***90,000***	*0*	*144,400*	*3,315 7/*	*N/A*	*0*
1. Natural flow and small storage	N/A	-	N/A	-	-			-	-	-			-			-	-
2. Storage reservoirs						314	680				32,800	90,000	-	144,400	3,215		
Timothy Lake (private)	51,740	-	N/A	P	-			-	-	-			-		-	-	-
North Fork (private)	5,994	-	N/A	P	-			-	-	-	21,800		-	-	-	-	-
3. Groundwater	-	-	-	-	-												
C. Total Residual Needs	-	-	-	-	-	*620*	*170*	-	*305,000 3/*	*764*	*13,800*	*(+42,000)*	*0*	*N/A 6/*	*1,627*	*4,882*	*N/A*
D. New Storage Accomplishments:	*201,000*	-	*3,360*	-	-	*388*	*170*	-	*110,000 3/*	*230*	-	*(+198,000)*	-	*18,000,000*	*1,630*	*295*	-
1. Early-action reservoirs - none	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Long-range reservoirs:																	
Big Bottom, site No. 451	120,000	-	1,660	-	FC,F&W,R,WQ,WS	208 8/	170	-	100,000	139	-	195,000 9/	-	-	830	165	-
Clear Cr., site No. 467	60,000	-	1,400	-	FC,F&W,R,WQ,WS	175 8/		-	41,500	63	-		-	-	700	130	-
Eagle Cr., site No. 497	21,000	-	300	-	FC,O 10/	-	-	-	9,000	28	-	-	-	-	-	-	-
Battle Cr., pumped-storage	50,400 11/	-	-	-	P	-	-	-	-	-	-	-	-	6,000,000	-	-	-
Cache Meadows, pumped-storage	14,800 11/	-	-	-	P	-	-	-	-	-	-	-	-	4,000,000	-	-	-
Cottonwood, pumped-storage	28,200 11/	-	-	-	P	-	-	-	-	-	-	-	-	6,000,000	-	-	-
Squaw Meadows, pumped-storage	11,400 11/	-	-	-	P	-	-	-	-	-	-	-	-	2,000,000	-	-	-
E. Year 2020 Conditions:																	
1. Subbasin storage totals	*268,700*	-	*3,360 12/*	-	-	*237 13/*	*0*	-	*195,000*	*534*	*13,800 14/*	*0*	-	*18,144,400*	-	-	-
2. Unmet needs	-	-	-	-	-	-	-	-	-	-	-	*237,000*	-	*N/A 6/*	*107*	*4,587 15/*	-
3. Additional capacity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

N/A Not available for subbasin or location

1/ Additional data are shown in Part V.
2/ Additional study to be made; see Part V.
3/ At mouth, as represented by Clackamas gage.
4/ Includes Portland service area municipal needs physically situated in Subbasin 9.
5/ No need in subbasin, or in Willamette River downstream from mouth of Clackamas River.
6/ Projections available only on a total-basin basis.
7/ Includes Willamette River.
8/ Capacity based on 1lb fish per surface acre; management practices discussed in Appendix D required for utilization of potential.
9/ Includes effect of storage in "firming up" available natural flow.
10/ Space not fully assigned; some available for other purposes.
11/ Closed system, storage therein not available for use outside the system.
12/ Excluding surface area of private power storage.
13/ Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.
14/ To be satisfied by storage in Molalla Division, Subbasin 7.
15/ Can be partially met by implementation of programs presented in Appendix K, Recreation.

irrigation. A portion of the new irrigation development can be expected to be provided by the private sector utilizing ground water, farm ponds, and natural flow. The remainder will be provided through the proposed Molalla Project as discussed in Subbasin 7. Soil and water restoration measures need attention at 12 identified locations on O&C forest lands and at 71 locations in National forests.

b. Long-range features. - Principal long-range features include three multiple-purpose storage projects; one single-purpose hydroelectric power project; four pumped-storage power projects; and some additional channel improvement for flood control.

(1) Big Bottom Reservoir, located on Clackamas River near river mile 65, would provide storage for flood control, recreation, fish and wildlife, and municipal and industrial purposes. It might also be operated to assist in meeting flow requirements for water quality improvement in the Portland harbor area. No other major reservoir in the plan would be so well-situated to meet emergency needs for additional flow in that area. The reservoir, as now proposed without specific provision for water quality flows, would have a capacity of about 120,000 acre-feet. That amount would be adequate to control a 100-year flood at the site. Recreation facilities would be provided around the 1,660-acre pool and the reservoir would also support a substantial resident fishery. Effects on fishery resources and stream-type environment would have to be given careful consideration. M&I withdrawals from Clackamas River are expected to increase substantially to meet demands both within and outside the subbasin. A portion of the storage required to firm up M&I supplies during the low-flow period could be provided by Big Bottom Reservoir.

(2) Clear Creek Reservoir project, on Clear Creek, a tributary of Clackamas River, would have a total capacity of about 60,000 acre-feet. It would have adequate storage space to control a 100-year flood at the site and to provide conservation storage for recreation, fish and wildlife, and municipal and industrial water supply purposes. Recreation facilities would be provided to take advantage of recreation and angling opportunities afforded by the 1,400-acre pool. Also, the reservoir would be available to furnish water for municipalities and

industries which are expected to make heavy demands on Clackamas River in the future.

(3) Watershed projects having the best potential for meeting needs after 1980 are Beaver Creek, Deep Creek, and Abernethy Creek. Current status of land use, development, and water-related problems for each of those watersheds are shown in Table A-1 of Addendum A to Appendix G. The principal structural measure involved would be a 21,000-acre-foot reservoir at site No. 497 on upper Eagle Creek.

(4) Shellrock hydroelectric project, located on Oak Grove Fork Clackamas River, would be a single-purpose power development. Water would be diverted from the river a few miles downstream from Timothy Lake and conveyed 4 to 5 miles downstream in a pipeline to develop about 925 feet of head. The power plant would have an installed capacity of about 35,000 kilowatts and generate an average of about 108 million kwh annually. The project might be a desirable addition to existing power facilities in the area, but the impacts on natural stream environment and fish life would require careful consideration.

(5) Pumped-storage hydroelectric power projects.--Four pumped-storage power sites appear promising and are included in the long-range phase on the premise that there will be a need in the basin for a large amount of peaking power capability after about 1990. The Power Appendix (J) indicates that those projects could make a substantial contribution toward meeting power demands of the basin. Pertinent data concerning those projects are contained in the following tabulation.

Name	Stream	Head, feet	Plant Capacity, megawatts
Battle Creek	Elk Lake Creek	1,080	6,000
Cache Meadow	S. Fork Roaring River	2,560	4,000
Cottonwood	Oak Grove Fork	1,990	6,000
Squaw Meadow	Roaring River	1,770	2,000

Because of the magnitude of the facilities involved, and as-yet-unknown potential for environmental impact, considerable additional study would be required before a final decision to construct could be made. Such study would have to include consideration of effects on fish and recreation, as well as the overall environment in an area where

preservation of significant natural environmental resources is proposed for early action.

(6) Other features would be primarily a continuation of uncompleted portions of the early-action proposals. More than 3 miles of channel stabilization and 2 miles of other channel improvement would be needed. In addition to those improvements and potential upstream flood control storage, an effective program of flood plain use regulation should be continued, with any modifications appropriate at that time. A considerable increase in recreation facilities will be needed beyond those included with the storage projects, requiring a continuing program for construction of facilities by Federal, State, and local governmental entities as well as private interests. Irrigation development during the long-range period is not expected to be extensive and necessary facilities would be expected to be provided by the private sector. In order to meet the future demand expected on this stream by municipalities and industries both within and outside the subbasin, additional diversion, conveyance, and treatment facilities will be required during the long-range phase. Those facilities would be provided by the municipalities and industries involved. A continuing program of waste treatment facility construction will also be required to maintain suitable water quality in the subbasin.

c. Opportunities. - In the event that economic conditions and water resource needs change, there are several development opportunities available, particularly in the area of electric power generation. One such opportunity is the Upper Austin Point site on Collawash River. That site could be developed to provide a multiple-purpose project, including about 38,000 kilowatts of power, if problems of potential shoreline instability can be resolved and economic justification shown. Other uses would be required for that purpose. Two potential single-purpose power sites, Fish Creek and Nowhere Meadows on Clackamas River, also have been identified. However, all of those developments would seriously affect recreational resources of the subbasin, and continuation of the early-action environmental management program is proposed.

In addition to the four pumped-storage hydroelectric sites proposed in the long-range phase, five other sites have been identified. Estimated maximum plant capacity of individual sites ranges from 2,000 to 6,000

megawatts. None of those sites were included in the plan because of their apparent incompatibility with recreational and environmental preservation considerations.

d. Remaining needs. - Except for flood control, storage development needs as of 2020 for Subbasin 9 apparently would be small. As indicated in Table IV-12, a need for additional storage for irrigation would be met from development in the adjoining Pudding Subbasin. There would be a surplus of storage for M&I use; however, that water could be used to assist in meeting the needs of Subbasin 10.

Tables V-6 through 14 summarize, by functions, projected needs and identified water-related accomplishments, generally for subbasin elements, for the plan as a whole.

SUBBASIN 10 - COLUMBIA



Subbasin 10, Columbia

The Setting

Columbia Subbasin is bisected from north to south by Willamette River, and bordered on the north by Columbia River. It includes a major part of Multnomah County and small sections of Washington, Columbia, and Clackamas Counties, and is composed largely of urban and suburban areas. The subbasin's 1960 population of 562,250 people was concentrated primarily within the Portland urban area.

The subbasin contains no major streams or drainages other than Willamette River. The eastern sector is drained by several small streams, including Johnson Creek, Mount Scott Creek, and Kellogg Creek. The western sector is drained by Scappoose and Milton Creeks.

The eastern portion of the subbasin is gently rolling, partly in the flood plain and partly on a plateau a few hundred feet higher. The western portion consists of low-lying flood plain, typified by Sauvie Island, and a long ridge rising from an elevation of about 20 feet along Willamette River and Willamette Slough to elevations of 1,000 and 2,000 feet along the edge of Tualatin Subbasin. The flood plain, a considerable part of which has been leveed, is affected by both Columbia and Willamette River flood stages

There are 431 square miles in the subbasin, of which 23 percent is agricultural, and 30 percent forest land. The remaining 47 percent includes residential and other urban development, associated service and industry, developed recreation areas, and lands owned or controlled by the State Game Commission.

The economy of the subbasin is basically that of the highly developed Portland area--wholesale and retail trade, electrical equipment and metals manufacturing, lumber and wood products, and agriculture and kindred food products. The northwestern portion of the subbasin, mostly in Columbia County, is oriented more towards lumber and wood products, agriculture, and fishing.

There are no major water resource developments in the subbasin. The most significant water-related needs are for flood control, fish and wildlife enhancement, water quality control, water-based recreation, and municipal and industrial water supplies for the Portland service area.

All of the small streams in the subbasin are in need of additional low-water flow to enhance salmonid production. In late summer, flows in the two largest tributary streams, Johnson and North Scappoose Creeks, commonly drop as low as 2 and 5 cubic feet per second, respectively. Much of the total Johnson Creek low flow originates in Crystal Springs, near the mouth, and is not available to the stream system as a whole. Summer water temperatures in lower portions of streams in the subbasin frequently range between 65° and 75°F. Those temperatures approach or exceed critical levels for salmon and trout. Water temperatures in most of the subbasin's nonstream water areas favor the production of warm-water game fish, and are also favorable for nongame fish such as carp and squawfish. Water temperatures in the lakes are so high that stocked trout connot be maintained to provide angling. Low dissolved oxygen concentrations, and occasionally toxic pollutants, cause fish problems in Willamette River during the low-flow season. Also, pollution commonly delays or prevents entry of anadromous fish into Scappoose and Milton Creeks. Further, water rights for consumptive use in the major fish-producing tributary stream systems total more than summer flows. Based on the foregoing, there is evident need for flow augmentation.

Oregon State Game Commission owns extensive lands on Sauvie Island. Those lands are being developed and managed for wildlife, particularly

migratory waterfowl; public hunting and fishing; and recreation. In spite of that development, which is heavily used, hunting opportunities are not equal to demands. The primary opportunities apparently are for the initiation and/or continuation of programs, described in Appendix D, for acquisition and improvement of habitat and for hunter access.

There are no existing or authorized reservoirs in the subbasin. Most of the Columbia-Willamette flood plain has been leveed, or is under consideration by the Corps of Engineers for levee construction and/or improvement under a separate study authorization. Upstream storage reservoirs in the Columbia River system, including Canadian storage under an International treaty, provide a considerable degree of protection against annual spring freshets on that stream. An authorized channel improvement project on Johnson Creek, for which authorization will expire in June 1971 if local cooperation is not forthcoming, would reduce damages on that stream. At present, annual flooding occurs on an area of more than 10,000 acres, mostly along Willamette River and Johnson Creek. There is a need for additional flood control for those areas and for channel improvement on several small tributaries.

Present irrigation requirements are relatively small in the subbasin. Because of its proximity to the rapidly expanding Portland metropolitan area, it is expected that by year 2000 urban encroachment will have converted all of the potentially irrigable and irrigated lands to non-agricultural uses, thereby eliminating the need for irrigation water.

Municipal and industrial water requirements for the communities and rural areas, excluding the Portland service area, are expected to increase nearly fourfold by 2020. Present sources, such as South Scappoose and Gourley Creeks supplying Scappoose and Columbia River for St. Helens, are adequate and it is unlikely that additional sources will have to be developed to meet future demands. There is a considerable ground water resource available for industrial uses, and increased usage is expected to occur. The Portland service area, although located primarily in Columbia Subbasin, involves portions of all the subbasins in the Lower Subarea. The service area will continue to be the most densely populated portion of the subbasin and will have the greatest demand for water.

Because the growing population and accompanying urban sprawl will limit areas available for recreation, it is unlikely that Columbia

Subbasin will ever become an outdoor recreation center. Development of water-related recreation facilities is one of the most pressing needs in the area. Private lands can satisfy a portion of the need. Much of the demand will be met by Willamette River. Full development of Columbia River, particularly its islands, is also needed. However, a deficit will still remain to be satisfied by other subbasins. Little opportunity for water-related recreation development exists on tributary streams in the subbasin. Johnson and Tryon Creeks, east and west, respectively, of Willamette River, however, offer some possibilities.

Water quality problems are experienced annually in Willamette River and the lower reaches of most tributaries. The Willamette River problem results from both upstream BOD loadings and the greatly reduced velocity and increased travel time in the enlarged tidal channel downstream from Willamette Falls. Even in consideration of anticipated adherence to Federally approved water standards, Appendix L shows a year 2020 need for flows up to 7,500 cubic feet per second in that reach to improve water quality to the extent that anadromous fish passage would be assured.

Subbasin Rationale

The proposed development features for Subbasin 10 are a reflection of limited resources available, and of the critical needs for flood control, fish and wildlife enhancement, and recreation.

The following discussions describe the proposed developments with accompanying rationale for selection. Table IV-13 presents a statistical summary of projected subbasin needs and anticipated storage accomplishments.

a. Early-action features. - The early-action proposal for Subbasin 10 is primarily for reduction of flooding and related damages. The authorized Johnson Creek Flood Control Project, if local cooperation becomes available, would have a favorable impact, but further flood prevention actions would be needed prior to 1980.

(1) Johnson Creek Watershed Project would be compatible with the authorized Johnson Creek Flood Control Project, or could function alone if that project were not constructed. The watershed project would include three reservoirs, with sufficient capacity to reduce flood peak flows of about 100-year frequency at the Sycamore gage on Johnson

Table IV-13
Projected water-related needs and storage accomplishments
Subbasin 10 - Columbia, 2020

Item	Storage Project Data 1/					Subbasin Needs and Accomplishments											
	Capacity, ac.-ft.		Full Pool Area, acres	Functions to be Served		Fish Life			Flood Control		Diversions, ac.-ft.		Navigation Flow, cfs	Power Cap., kw	Recreation 1,000 rec-days		Water Quality Control, cfs
	Total	To be Assigned 2/		Auth.	New	Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs	Warm Water, No. of Fish, 1,000's	ac.-ft.	sq. mi.	Irrigation	M&I Supply			Resource Capacity	Facilities	
A. Projected Subbasin Needs:	-	-	-	-	-	*67*	-	*352*	-	-	*0*	*761,000*	*0* 3/	*N/A* 4/	*18,839*	*18,839*	*7,500* 5/
1. Scappoose Cr., @ mouth	-	-	-	-	-	-	65	-	N/A	-	-	-	-	-	-	-	-
2. Willamette R.	N/A	-	-	-	-	-	-	-	3,700,000 6/	7,458	-	-	-	-	-	-	7,500
B. Presently Assured Accomplishments:	*N/A*	-	*N/A*	-	-	*22*	-	*119*	-	-	*N/A*	*285,000*	*N/A* 3/	*28,800*	*4,994* 7/	-	*4,636* 5/
1. Natural flow and small storage	N/A	-	N/A	-	-	-	-	119	-	-	-)	)	)	29,800	-	-)	
Scappoose Cr., @ mouth	-	-	-	-	-	-	0	-	-	-	-)	285,000)	6,000	-	-	-)	4,636
2. Storage reservoirs	2,861,500	-	41,055	N/A	N/A	-	-	-	1,850,000 6/	3,277	-)	)	)	-	-	-)	
Willamette R.	-	-	-	-	-	-	-	-	-	-	-)						-
3. Groundwater	-	-	-	-	-	*46*	-	*233*	-	-	*0*	*476,000*	*0*	*N/A* 4/	*7,845*	*18,839*	*2,864* 5/
C. Total Residual Needs:	-	-	-	-	-	-	55	-	-	-	-	-	-	-	-	-	-
1. Scappoose Cr. @ mouth	-	-	-	-	-	-	-	-	1,850,000 6/	4,181	-	-	-	-	-	-	2,864
2. Willamette R.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
D. New Storage Accomplishments:	*38,890*	-	*1,400*	-	-	*23*	-	-	*11,600* 8/	*33*	-	-	-	-	*130*	*130*	*2,205* 8/
1. Early-action reservoirs:																	
Trib. Johnson Cr., site No. 515	3,260	-	180	-	FC,R	*23* 10/	-	-	900	4	-	-	-	-	90	90	-
Trib. Johnson Cr., site No. 591	1,080	-	100	-	FC	-	-	-	1,000	4	-	-	-	-	-	-	-
Johnson Cr., site No. 592	1,010	-	80	-	-	-	-	-	900	4	-	-	-	-	-	-	-
Subtotals	5,350	-	360	-	-	23 10/	-	-	2,800	12	-	-	-	-	90	90	-
2. Long-range reservoirs:																	
Milton Cr., site No. 510	10,000	-	300	-	FC,O 11/	-	-	-	3,000	9	-	-	-	-	-	-	-
N. Scappoose Cr., site No. 513	18,200	-	540	-	FC,O 11/	-	-	-	5,800	18	-	-	-	-	-	-	-
Fairview Lake, site No. 566	1,740	-	200	-	R,O 11/	N/A	-	-	-	-	-	-	-	-	100	40	-
Subtotals	29,940	-	1,040	-	-	N/A	-	-	8,800	27	-	-	-	-	100	40	-
E. Year 2020 Conditions:	-	-	-	-	-	-	-	-	-	-	-	-	-	28,800	-	-	-
1. *Subbasin storage totals*	*38,890*	-	*1,400*	-	-	*22* 12/	*N/A*	*233* 12/	*13/*	-	*0*	*486,000*	-	*N/A* 4/	*7,955*	*18,709* 14/	*858* 5/
2. *Unmet needs*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. *Additional capacity*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

N/A Not available for subbasin or location

1/ *Additional data are shown in Part V.*
2/ *Additional study to be made; see Part V.*
3/ *No specific requirement in subbasin; Willamette River minimum water level is controlled by Columbia River level and tidal effects.*
4/ *Projections only on a total-basin basis.*
5/ *Through the Portland harbor area, in August.*
6/ *Effective at Willamette Falls, where Willamette River enters the subbasin.*
7/ *Includes Columbia and Willamette Rivers.*
8/ *Effective on tributaries; no effect on Willamette River.*
9/ *Includes plan accomplishments outside of subbasin.*
10/ *Capacity based on 138 fish per surface acre; management practices discussed in Appendix D required for utilization of potential.*
11/ *Capacity shared on 1/3 fish, assigned; some available for other purposes.*
12/ *Space not fully assigned; some available for other purposes.*
13/ *Can be met by implementation of access and management programs discussed in Appendix D, Fish and Wildlife.*
14/ *Can be met by implementation of water needs unrelated to flow in or storage on subbasin streams.*
Willamette River needs unrelated to flow in or storage on subbasin streams.
Can be partially met by implementation of programs presented in Appendix K, Recreation.

Creek by about 33 percent. Water-based recreation would be associated with the reservoirs. The three reservoirs would provide a combined storage of about 5,350 acre-feet, with about 360 acres of surface area. Consideration should be given to developing a resident fishery impoundment at site No. 591, as discussed in Appendix D.

(2) Fairview Creek Watershed Project would consist of about 3 miles of channel improvement and incorporation of appropriate land treatment practices. The proposed project would reduce the average annual flood plain from about 90 acres to 10 acres and reduce flood damages in the watershed by 95 percent.

(3) Other features. - To further satisfy needs for recreation and fish and wildlife enhancement, a number of nonproject measures should be implemented. Such measures and activities should include acquisition and development of a mineral spring near Scappoose to enhance band-tailed pigeon habitat and hunting opportunities; acquisition of about 2,000 acres to be added to the Sauvie Island Game Management Area for waterfowl habitat and shooting accommodations; and expanded private-sector and governmental recreation developments, particularly along Willamette and Columbia Rivers. Implementation of a zoning plan to control urbanization and industrialization of lands needed for outdoor recreation is of primary importance, as is local regulation of flood plain use in the interest of flood damage reduction. There is also an early need to install four small group enterprise jobs on agricultural lands involving drainage outlets and channel improvement; and to correct soil and water restoration problems at two locations on O&C forest lands.

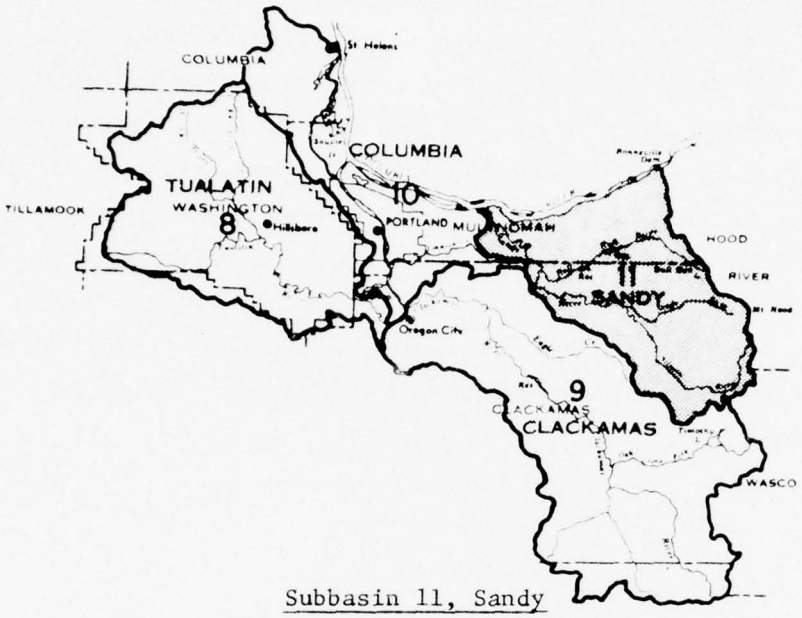
b. Long-range features. - Long-range proposals were formulated on the basis of available resources, physical and economic potential, and capability to satisfy the most critical water needs in the subbasin. Principal elements are multiple-purpose storage in watershed projects.

Watershed projects having the best potential for meeting needs after 1980 are Milton Creek and Scappoose Creek. Current status of land use, development, and water-related problems are shown in Table A-1 of Addendum A to Appendix G. Principal structural measures involved would be: (a) an 18,200-acre-foot reservoir at site No. 513 on upper Scappoose Creek, (b) a 10,000-acre-foot reservoir at site No. 510 on

Milton Creek, (c) a 1,740-acre-foot reservoir at site No. 566 on Fairview Creek, and (d) about 5 miles of tributary channel improvements.

c. Remaining needs. - Water resource development in Subbasin 10, as discussed in this section, would satisfy identified needs in most functional fields. There would still be a remaining need for municipal and industrial water supply in the Portland service area; however, under the proposed plans these needs would be met from development in other subbasins. Also, there would be a substantial unmet need for water-related recreation capacity and facilities, fish and wildlife, and for increased flow and improved water quality in some of the tributaries. Table IV-13 shows subbasin needs, storage accomplishments, and remaining needs. Tables V-6 through 14 summarize needs and accomplishments for the basin as a whole.

SUBBASIN 11 - SANDY



Subbasin 11, Sandy

The Setting

Subbasin 11, Sandy, is made up primarily of the Sandy River drainage area. It is bounded to the north by Columbia River, to the east by the western boundary of Hood River County, and to the south and west by Subbasins 9 and 10. This is the only subbasin in the study which does not drain into Willamette River or Willamette Slough. Sandy River flows directly into Columbia River near Troutdale. Main tributaries, all with headwaters in the Cascade Range, include Bull Run, Upper Sandy, Zigzag, and Salmon Rivers. Also, several small subbasin streams flow directly into Columbia River.

Living glaciers on Mt. Hood are the origin for Sandy, Zigzag, and Salmon Rivers. Glacial action contributes the glacial silt which gives Sandy River its name and character. Bull Run River is separated by a thin ridge system from the glaciers on picturesque Mt. Hood, and has very clear, clean water. The Bull Run Watershed is closed to public entry in the interest of preserving the purity of its waters for municipal use.

The subbasin contains 582 square miles. About 70 percent is located in Clackamas County and the remainder in Multnomah County. Forests cover about 90 percent of the land. Agriculture and other uses about equally divide the remainder. Forest products, recreation, and agriculture constitute the economic base of the subbasin.

Principal cities in Sandy Subbasin include Sandy and Troutdale. The 1960 population totaled 9,700 people. That figure is expected to increase about 2.5 times, to a projected population of 22,800 people, by year 2020.

As shown in table II-3, existing water resource development in the subbasin consists of six storage impoundments: four for municipal water supply, one for power generation, and one recreation development. All of the existing development has been accomplished by non-Federal entities.

There are several legal restrictions placed on streams in Sandy Subbasin. The oldest and largest single restriction is on Bull Run and Little Sandy Rivers. In 1891, the Oregon State Legislature withdrew those waters for municipal use by the City of Portland. At present, those streams supply about 98,000 acre-feet of water to the Portland service area for municipal and industrial use annually.

Sandy River and its tributaries, except Beaver, Buck, Big, and Trout Creeks, were withdrawn for protection of fish life by the Oregon State Legislature in 1953. However, with the exception of Hackett Creek, appropriation and use of those waters is allowed for domestic, stock, municipal, public park, or recreational purposes. In addition, all of the tributaries, except Sandy River downstream from Big Creek, are open for appropriation and storage from December 1 to June 1 of each year.

Existing streamflows are sufficient in most cases to meet recommended minimum fish flows. Optimum fish flows are met on Sandy River except in the reach from Marmot Dam downstream to Bull Run River. Diversions at the dam, for power generation, often reduce flows downstream to the point of return at the mouth of Bull Run to less than minimum for fish life. Water temperatures in the streams, other than lower Sandy River, seldom exceed 65°F. Barriers to fish passage include Marmot Dam on Sandy River, Little Sandy Dam on Little Sandy River, Bull Run Dams No. 1 and 2 on Bull Run River, and several falls on both streams. There

are several possibilities of resolving the barrier problems, including trapping and hauling around the barriers, and laddering; however, no action has been taken. Another fish-passage problem involves the severe daily fluctuation in flow of Sandy River because of power peaking operations on Bull Run River. To meet the demands for resident fisheries will require additional stocking and water surface area, and improved access to the Cascade lakes.

Basin-wide supplies of many species of wildlife are insufficient and, for some, demands cannot be satisfied in the future. A significant exception is fur animals, for which the supply is greater than the limited demand.

There are no existing or authorized storage or local flood control projects in Subbasin 11 and flooding occurs annually on about 2,600 acres. Because there are no promising storage sites in the downstream reaches of Sandy River, it is probable that locally accomplished flood plain use regulation will provide the only effective control over flood damages. Needs for channel stabilization have been identified for about 4 miles on Sandy River.

There are no irrigation projects in Sandy Subbasin and the potential for irrigation is limited. All surface waters of the subbasin have been withdrawn from further irrigation appropriation, except the tributaries to lower Sandy River. Any further irrigation development would be expected to depend on the use of ground water, storage in farm ponds, or pumping from Columbia River.

Bull Run Watershed, within Sandy Subbasin, is the largest single source of municipal supply for the Portland service area. Bull Run River and Little Sandy River drainages have been withdrawn by the Oregon Legislature to insure an adequate supply of good quality water for the City of Portland. The existing Bull Run storage, plus planned expansion, will be adequate until sometime after the year 2000. Beyond that time, additional municipal and industrial water needs for the Portland service area would have to be developed from sources outside of Sandy Subbasin. Water supplies for the towns and communities within the subbasin appear generally adequate through year 2020, with the exception of Zigzag which will require additional water rights.

Existing recreation facilities are adequate to meet the present demand; however, projected demands indicate there will be a need for

nearly twice the facility capacity by 2020. Existing water surface area, within the subbasin, if totally available for public use, could satisfy about two-thirds of the 1980 demand. Without additional water surface area, less than 40 percent of the recreation demand could be met in 2020. To satisfy the growing recreation demand in terms of opportunities and facilities would require participation on a broad scale from private-sector to multiagency project-type development.

There are no existing water quality or pollution problems in the subbasin, nor are any expected in the future.

Subbasin Rationale

A review of the water and related land resource needs in Sandy Subbasin shows that the principal water-related needs are for flood control, recreation, fish and wildlife enhancement, and municipal and industrial water supplies. In view of the few storage development opportunities, it appears that effective programs and nonstorage projects offer the best opportunity to meet the water-related needs in the subbasin. The following discussions describe the proposed measures, with accompanying rationale for selection. Table IV-14 presents a statistical summary of the major water-related needs and anticipated storage accomplishments in the subbasin as of 2020.

a. Early-action features. - About one-third of the unstable reaches along Sandy River should receive channel stabilization works by 1980. That work should be coordinated with recreation and fish and wildlife interests.

A program of flood plain use regulation and zoning along Sandy River should be implemented by local government. The program should provide for retention of the rugged natural beauty of the river for recreation use, as well as for flood damage reduction in the future.

Additional municipal and industrial water supplies will be required during the early-action period by the City of Portland. The City has plans to increase storage in the Bull Run watershed by about 34,000 acre-feet (11,000 mg) by 1985. In addition to the municipal and industrial water supply development, it is recommended that the U.S. Forest Service (in cooperation with the City of Portland, the fishery agencies, and others interested) investigate the possibility, and the

Table IV-14
Projected water-related needs and storage accomplishments
Subbasin 11 - Sandy, 2020

Item	Storage Project Data 1/ Capacity, ac.-ft. Total	To be Assigned 2/	Full Pool Area, acres	Functions to be Served Auth.	New	Fish Life Trout, No. of Fish, 1,000's	Anadromous, Flow, cfs	Warm Water, No. of Fish, 1,000's	Flood Control ac.-ft.	Flood Control sq. mi.	Diversions, ac.-ft. Irrigation	Diversions, ac.-ft. M&I Supply	Navigation Flow, cfs	Power Cap., kw	Recreation, 1,000 rec-days Resource Capacity	Recreation, 1,000 rec-days Facilities	Water Quality Control, cfs
A. *Projected Subbasin Needs*	-	-	-	-	-	323	526 3/	3	200,000	387	18,900	4,000	0	N/A 4/	5,940	5,940	-
B. *Presently Assured Accomplishments:*	71,000	-	1,450	-	-	109	526 3/	1	0	-	18,900	106,000	0	21,000	2,320 5/	-	-
1. Natural flow and small storage																	
Bull Run (4 reservoirs plus powerplant 6/)	71,000	-	1,450	WS,P	-	N/A	525	-	-	-	-	98,000	-	21,000	2,320	-	-
Other	-	-	-	-	-	N/A		1	-	-	8,900	3,500	-	-		-	-
2. Ground water	-	-	-	-	-	-	-	-	-	-	10,000	500	-	"		-	-
C. *Total Residual Needs*	-	-	-	-	-	214	0	2	200,000	387	0	(+88,000) 7/	0	N/A 4/	3,620	5,940	-
D. *New Storage Accomplishments:*	N/A	-	N/A	-	-	-	-	-	-	-		184,000 7/	-	N/A	N/A	-	-
1. Early-action reservoirs																	
Bull Run, storage increase	34,000	-	N/A	-	WS	-	-	-	-	-	-	154,000	-	N/A	N/A	-	-
2. Long-range reservoirs																	
Bull Run, storage increase	N/A	-	N/A	-	WS	-	-	-	-	-	-		-	N/A	N/A	-	-
E. *Year 2020 Conditions:*																	
1. *Subbasin storage totals*	N/A	-	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. *Unmet needs*	-	-	-	-	-	214 8/	-	2 8/	200,000	387	0	0	-	N/A 4/	3,620	5,940 9/	-
3. *Additional capacity*	-	-	-	-	-	-	-	-	-	-	-	282,000 7/	-	-	-	-	-

N/A Not available for subbasin or location

1/ Additional data are shown in Part V.
2/ Additional study to be made; see Part V.
3/ At Troutdale.
4/ Projections only on a total-basin basis.
5/ Includes Columbia River; Bull Run Watershed is closed to public entry, and its potential is not presently available.
6/ City of Portland water supply system and Portland General Electric Company powerplant.
7/ To be used in Subbasin 10, Portland Service Area; estimated capacity of existing conveyance facilities.
8/ Can be met by implementation of access and management programs discussed in Appendix I, Fish and Wildlife.
9/ Can be partially met by implementation of programs presented in Appendix K, Recreation.

social and political implications, of opening the Bull Run watershed to other types of public use, particularly recreation, fishing, and hunting.

Other elements named for early-action implementation include recreation facilities--water and nonwater related; fish-passage facilities at the principal stream barriers; improved access to fishing and recreation sites, as well as studies to analyze the recreational significance of the Barlow Road and Columbia Gorge; and irrigation facilities to serve the projected increase in irrigated land. The bulk of the recommended facilities would be developed and provided by the private sector. Some aspects would be eligible for Federal assistance or cost sharing.

b. Long-range features. - Elements proposed for long-range action consist of follow-up and continuation of measures recommended for early action. Additional storage will be needed during the long-range period to supplement Portland's municipal and industrial water supplies in the Bull Run watershed. Other elements should include additional channel stabilization on Sandy River; continued efforts toward enhancement of fish and wildlife resources; Federal and non-Federal participation in developing recreation areas and facilities; and private sector development of irrigation facilities.

c. Opportunities. - If at a later time it becomes desirable or needed, there is one favorable opportunity for storage development. Linney Reservoir at site No. 526 on Salmon River, could be developed to serve needs including those for flood control, recreation, and fish and wildlife enhancement. Although there will be a considerable need for additional municipal and industrial water for the Portland service area, the potential sites in Clackamas River watershed appear more favorably located to supply those demands than the Linney project. The reservoir could be operated to control a 100-year flood at the site, and to provide a sizable water surface area for recreation and fishing. Streamflow augmentation would enhance fishery habitat on both Salmon River and Sandy River downstream from Marmot Dam.

d. Remaining needs. - Remaining needs as of 2020 in Subbasin 11 would be small. Table IV-14 indicates that there would be some need for additional flood control measures; however, it is expected that the need could be satisfied by an adequate flood plain use regulation program.

THE FINAL PLAN - CONSOLIDATION AND REFINEMENT

Plan formulation culminated in decisions as to elements of the final plan--the comprehensive basin plan described in Part V. The overall procedures provided the essential matching of needs and potentials at various levels--local and watershed, subbasin, and basin-wide. Conducted concurrently and in coordination, those procedures provided both rationale and analyses to confirm selection of compatible elements.

The overall plan, and a summary of its accomplishments; details, effects, and impacts of early-action elements; remaining unmet needs; and a summary of alternatives and remaining opportunities are presented in Part V.

Consolidation

Because the work of plan formulation had been coordinated, final consolidation was simple. In a few instances, local-choice options as to alternative minor elements of the plan were found to exist. Each of those alternatives was included in the plan, and appropriately identified in Part V.

Final Refinements

In addition to consolidation, as discussed in the foregoing paragraphs, certain additional refinements were made. Those refinements, discussed herein, completed the steps necessary to define the comprehensive basin plan.

Included were: (1) further consideration of the concept of management to preserve and protect the desirable aspects of natural environment, and a basin-wide program for implementation; and (2) final basin-system hydraulic analyses of storage elements, using the electronic computer, to verify the adequacy and appropriateness of the consolidated plan.

Environmental Management

Addendum A to Appendix K, Recreation, contains details, by subbasins and for Willamette River proper, of needs and potentials for or related to recreation and preservation. Included are certain conclusions of the multiagency Recreation Committee as to opportunities and needs for

preservation, management, and protection of natural environmental resources. Addendum A is supplemented by a subsequent letter, from the Recreation Committee, providing additional detail on preservation potentials and specific recommendations for preservation management. That letter is Addendum E to this appendix.

The timing of Addendum E was such that environmental consideration throughout most of the study period was principally on the basis of data obtained informally from agencies, groups, and individuals. Therefore, at the end of the study, it was necessary to compare consolidated development plans with recommendations shown in Addendum E, and make appropriate adjustments or refinements. All such actions were taken on the basis, discussed under Procedures and Criteria for Planning, that management actions for preservation could be modified, if appropriate, on the basis of additional knowledge in the future. Any such future change would represent exercise of the freedom-of-choice privilege, in the interest of the well-being of people as defined and recognized at that time.

Environmental considerations subsequent to the letter attached as Addendum E resulted in the decision to set certain potential projects aside in favor of management under an early-action preservation program. Table IV-15 lists the potential projects, on environmental management streams, which were not included in the plan.

Final Hydraulic Analyses

Upon completion of the foregoing refinements, final hydraulic analyses of the storage plan (existing, assured, and early-action projects) were made. Those analyses showed the degree of accomplishment in meeting physical needs. They did not show need for any further change in plan.

Table IV-15

Potential developments, on environmental management streams, not included in the plan

Subbasin and Stream	Project Name	Project Type 1/	Power Site Withdrawal and No. 2/
1, Coast Fork:			
Coast Fk. Will. R.	Cottage Grove #3	MP	-
2, Middle Fork:			
N. Fk. M. Fk. Will. R.	Upper N. Fork	MPP	PSC 310
3, McKenzie:			
McKenzie R.	Twisty Cr.	MPP	-
McKenzie R.	Foley Ridge	MPP	-
McKenzie R.	Belknap	SPP	-
McKenzie R.	Thurston	MP	-
Horse Cr.	Horse Cr.	MPP	PSR 664
S. Fk. McKenzie R.	Rebel Cr.	MPP	-
12 basin sites	Pumped-storage	SPP	-
4, Long Tom:			
None	-	-	-
5, Santiam:			
N. Santiam R.	Marion Lake	SPP	-
N. Santiam R.	Tunnel	MPP	PSC 291
N. Santiam R.	N. Santiam	SPP	PSR 661 PSC 426
Breitenbush R.	Elk Lake, pumped	SPP	PSC 291
Breitenbush R.	Byars Cr.	MPP	PSC 291
L. N. Santiam R.	Canyon Cr.	MPP	-
M. Santiam R.	Bear Cr.	MPP	-
S. Santiam R.	Patterson	MPP	-
6, Coast Range:			
Marys R.	West Marys	MP	-
7, Pudding:			
Butte Cr.	Coal Cr.	MP	-
8, Tualatin:			
None	-	-	-
9, Clackamas:			
Clackamas R.	Tarzan Spring, pumped	SPP	-
Clackamas R.	Nowhere Meadows	SPP	-
Clackamas R.	Fish Cr.	SPP	-
Collawash R.	Upper Austin Pt.	MPP	-
10, Columbia:			
None	-	-	-
11, Sandy:			
Salmon R.	Linney	MP	-

1/ MP, multiple-purpose; MPP, multiple-purpose with power; SPP, single-purpose power.

2/ Under authorities discussed on page II-29. PSC, power site classification, and PSR, power site reserve, designate areas identified as valuable for water power development.

THE COMPREHENSIVE BASIN PLAN

THE OVERALL PLAN

This section summarizes the overall comprehensive plan. No details are presented. The ensuing section of Part V presents descriptions of early-action elements. Those include ongoing programs, to be continued and/or accelerated; new programs, to be initiated as soon as possible; and new projects, to be initiated in the next 10 to 15 years.

SUMMARY DESCRIPTION

The overall comprehensive plan is a composite. It provides for use of resources to meet a majority of present and projected demands on land, water, and related resources. At the same time, it preserves for the future a considerable measure of freedom of choice, and identifies a reserve of development potential as opportunities for the future.

The plan was formulated in consideration of needs which now exist and of those projected for 1980, 2000, and 2020. It provides for service in all functional fields now recognized. Those are fish and wildlife, flood control, irrigation, municipal and industrial water supply, navigation, power generation, recreation, and water pollution control and quality improvement. It provides for multiple-purpose land measures and watershed protection programs to restore and preserve soil and hydrologic normality and to maintain good water quality. It provides for management to protect and preserve unique and desirable natural resources, in the foreseeable future, for the well-being of people.

The plan is a framework which includes existing, authorized, assured, and potential new elements. It would be implemented on a coordinated basis by private-sector, public non-Federal, and Federal entities, singly and in cooperation. Potential new elements are identified for early action and long-range consideration. Early-action elements are those on which action should be taken within the next 10 to 15 years. Long-range elements should be considered for study at times consistent with accomplishment from about 1985 to 2020. The total plan listing also includes identified opportunities for further development which should be considered in future studies.

Functional Makeup of the Plan

Programs and projects would be used, under the comprehensive plan, to serve all presently recognized water and related resource needs. The specific purposes to be served, and the plan features providing service in each functional field, are summarized as follows:

Purposes to be served	Plan Features Involved		
	Projects		
	Storage	Nonstorage	Programs
Fish and Wildlife	x	x	x
Flood Control	x	x	x
Irrigation	x	x	x
M&I Water Supply	x		x
Navigation	x	x	x
Power	x	x	x
Recreation	x	x	x
Water Pollution Control	x		x

In addition, the plan includes an environmental management program, multiple-purpose land measures and watershed treatment programs, hydrologic data collection programs to serve all purposes, and a multiple-purpose streamflow forecasting program. All projects would be planned to minimize adverse environmental impacts of construction and operation.

Physical Makeup of the Plan

The plan includes all of the ongoing programs related to functions and other considerations, as discussed in Appendixes D through L and summarized in subsequent text on early-action elements of the plan. It includes a proposed new program for environmental management of specific streams and adjoining lands. It also includes a wide range of storage and nonstorage projects.

Subsequent text in this section of Part V summarizes program and project elements of the comprehensive basin plan. Program elements, summarized under appropriate functional and descriptive headings, are complementary or supplemental to the subsequently summarized project elements. Projects are summarized in storage and nonstorage categories.

Costs of the Comprehensive Plan

The overall comprehensive plan would involve an identified investment by the year 2020 in the order of $6 billion in projects and permanent improvements under programs. As of that date, the average annual identified cost of operation and maintenance for the overall plan would be more than $130 million. The following tabulation summarizes identified costs.

Plan Elements and Categories	Estimated Costs, $1,000,000	
	Investment	Annual O&M
Programs:		
Functional	1,070	69.32
Other	89	0.63
Subtotals	1,159	69.95
Projects:		
Existing	441	3.11
Authorized and assured	191	0.91
Early-action	695	6.37
Long-range	3,260	50.00
Subtotals	4,587	60.39
Identified Plan Costs 1/	5,746	130.34

1/ Based on price levels generally as of 1968.

It has not been possible to identify and assess the costs or values of all permanent improvements under ongoing programs. Neither has it been possible to project all program costs for the period after 1980-85. Thus, the figures shown for investment to date, and total future investment, in programs do not represent total program costs from initial use to the year 2020.

Cost allocations for individual projects will be made in subsequent studies for individual agency reports, based on and supported by data herein plus additional detail yet to be developed. Thus, neither the total Federal and non-Federal shares of cost nor the total costs allocable to individual functions are known.

Economic Feasibility

Economic analyses have been made for early-action-project elements of the comprehensive plan. Each subsequent project description shows economic analysis data, based on studies to date and subject to possible detailed adjustment as a result of additional agency study. Those data are based on an interest rate of 4-5/8 percent and amortization periods consistent with the nature of the projects involved. In general, multiple-purpose project analyses are based on a 100-year economic life; single-purpose projects and small local works generally are analyzed on the basis of an economic life of 50 years or less.

A comparison of identified total average annual costs and benefits shows that, overall, the early-action-projects portion of the plan would have a benefit-to-cost ratio in the order of 1.2 to 1.

In general, program benefits have not been quantified. Many of the programs included in the plan are ongoing, rather than new, and are based on existing legislative, policy, and/or "well-being" determinations, rather than on economic analysis. Most of those programs, as well as new programs, are not susceptible to strict economic analysis. An indication of program merit and economic feasibility, however, is available from an approximate analysis of the fish and wildlife programs proposal. That analysis shows that implementation of the overall fish and wildlife proposal, during the early-action period, would return benefits equal to almost five times the costs to be incurred during the period.

PROGRAMS, OVERALL

Programs make up a highly significant segment of the comprehensive basin plan. In many instances, programs and data to be obtained under programs are essential to planning for and proper operation of projects in the plan. In others, programs are complementary and/or supplemental to projects.

Included are all ongoing water, land, and related resource programs, and one important new program. Many of the ongoing programs would be accelerated, during the early-action period, to a level consistent with meeting rapidly growing present and projected needs.

In many cases, it has not been possible to identify and summarize total investment to date in programs, or even in those existing permanent improvements which have resulted from overall program activities. Similarly, the many variables involved make it difficult to quantify investment requirements for long-range components of program proposals. In order to indicate representative magnitudes of cost, some estimates have been developed based on criteria not specifically defined in this report. The identified overall cost of programs in the plan is in the order of $1.2 billion, or about 20 percent of total identified plan cost.

The programs involved generally are functionally oriented. However, the overall streamflow forecasting program, the land measures and watershed protection programs, and the water resource data collection programs serve multiple purposes. The proposed new environmental management program is to maintain the quality of life and for the overall well-being of people.

Each program would consist of features as described subsequently in text on Early-Action Elements of the plan. That text shows responsibilities for program implementation. Table V-1 summarizes the general nature and estimated cost of identified programs.

Table V-1

Programs in the comprehensive plan, 2020

Programs	Estimated Costs, $1,000,000	
	Investment 1/	Annual 2/
Functional:		
Fish and wildlife	216	21.74
Flood control 3/	3	N/A
Irrigation	112	2.23
M&I water supply 4/	80	6.80
Navigation	N/A	N/A
Power	N/A	N/A
Recreation	150	1.75
Water pollution control	509	36.80
Subtotals 5/	1,070	69.32
Other:		
Land measures and watershed protection	88	N/A
Environmental management	N/A	N/A
Precipitation reporting network	1	0.09
Radar weather surveillance	N/A	N/A
Air pollution control support	N/A	N/A
Streamflow forecasting	N/A	0.54
Subtotals 5/	89	0.63
Total program costs 5/	1,159	69.95

1/ Includes investment in existing permanent improvements, where identified; in early-action programs; and, where identified, long-range programs.

2/ Operation, maintenance, replacement, and administration.

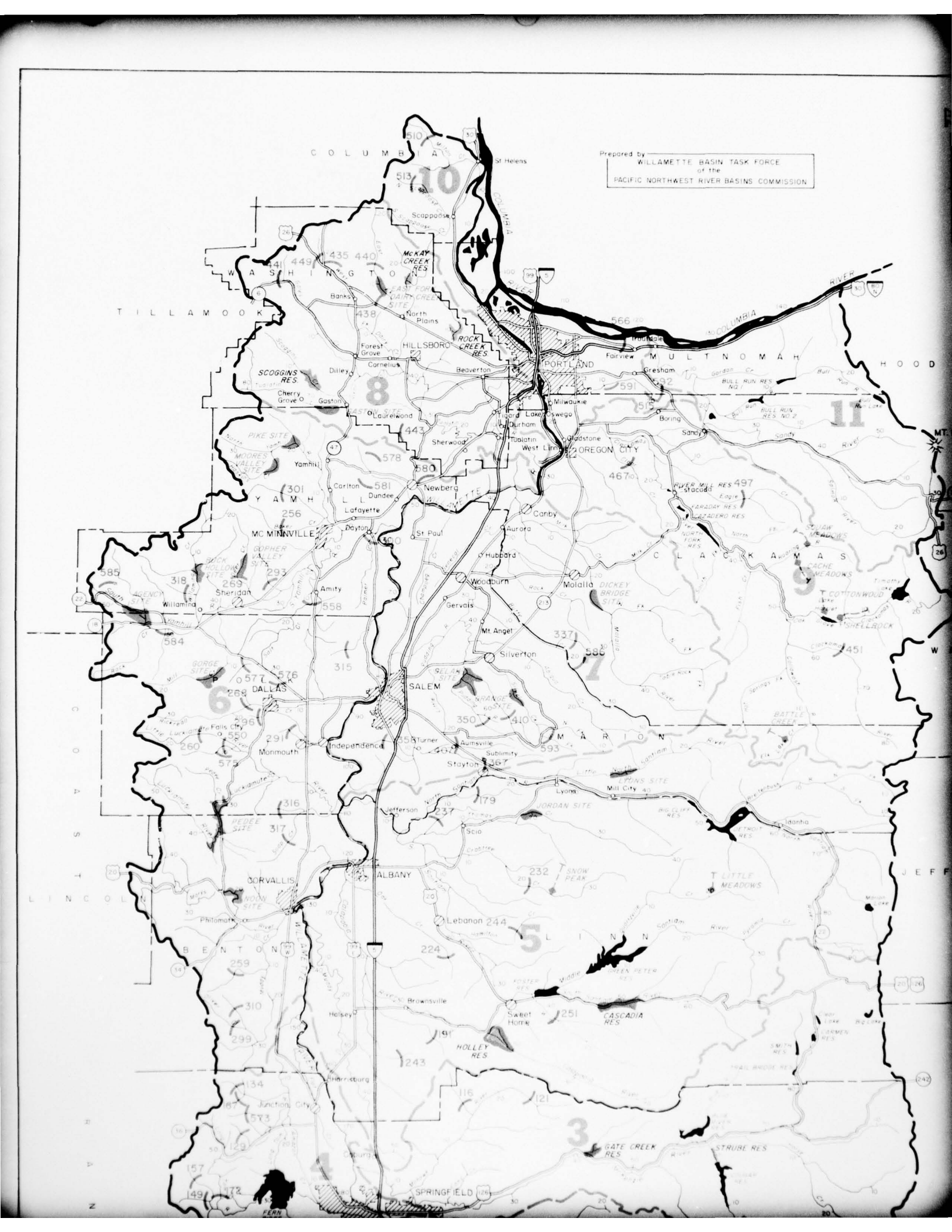
3/ Flood plain information program. Early-action only; long-range not available.

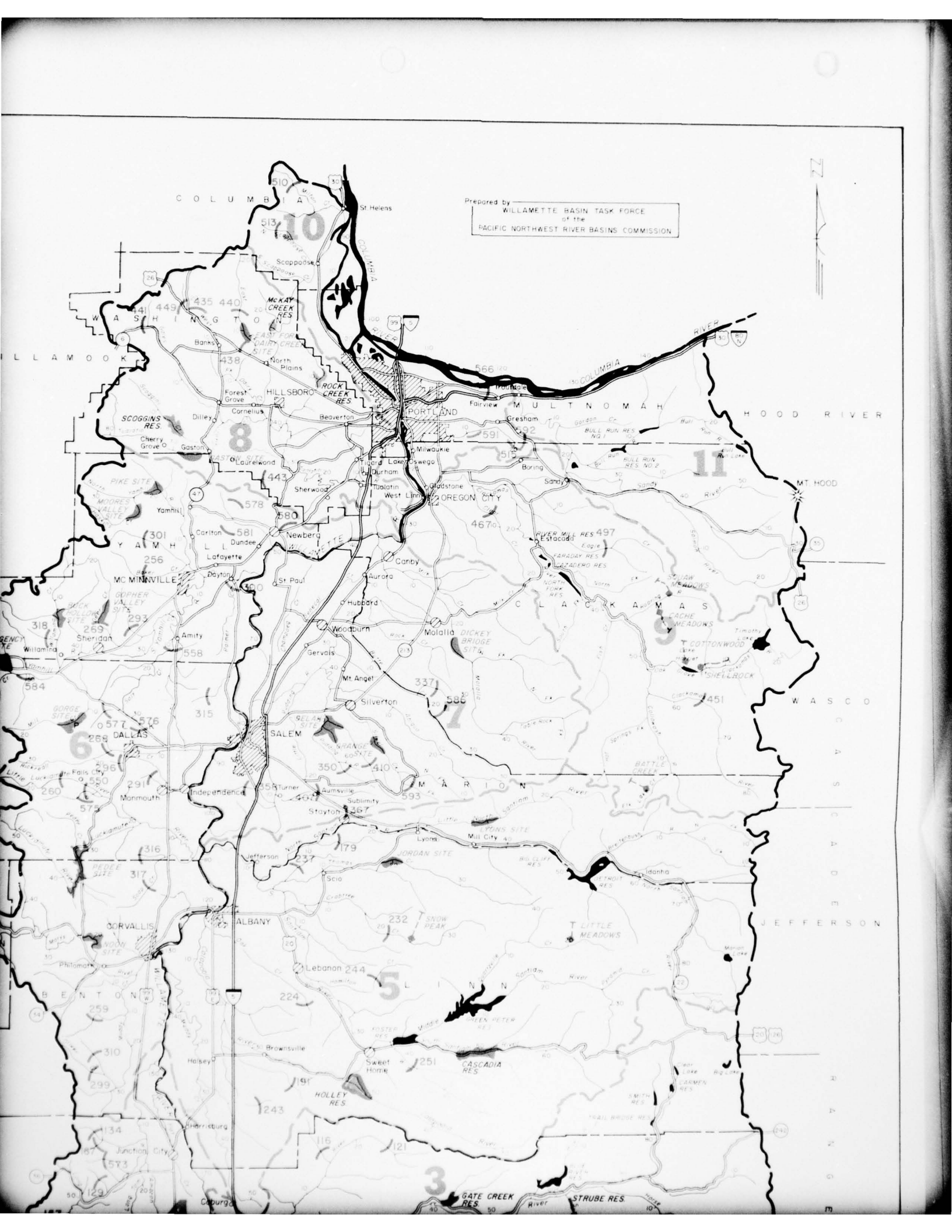
4/ For water treatment.

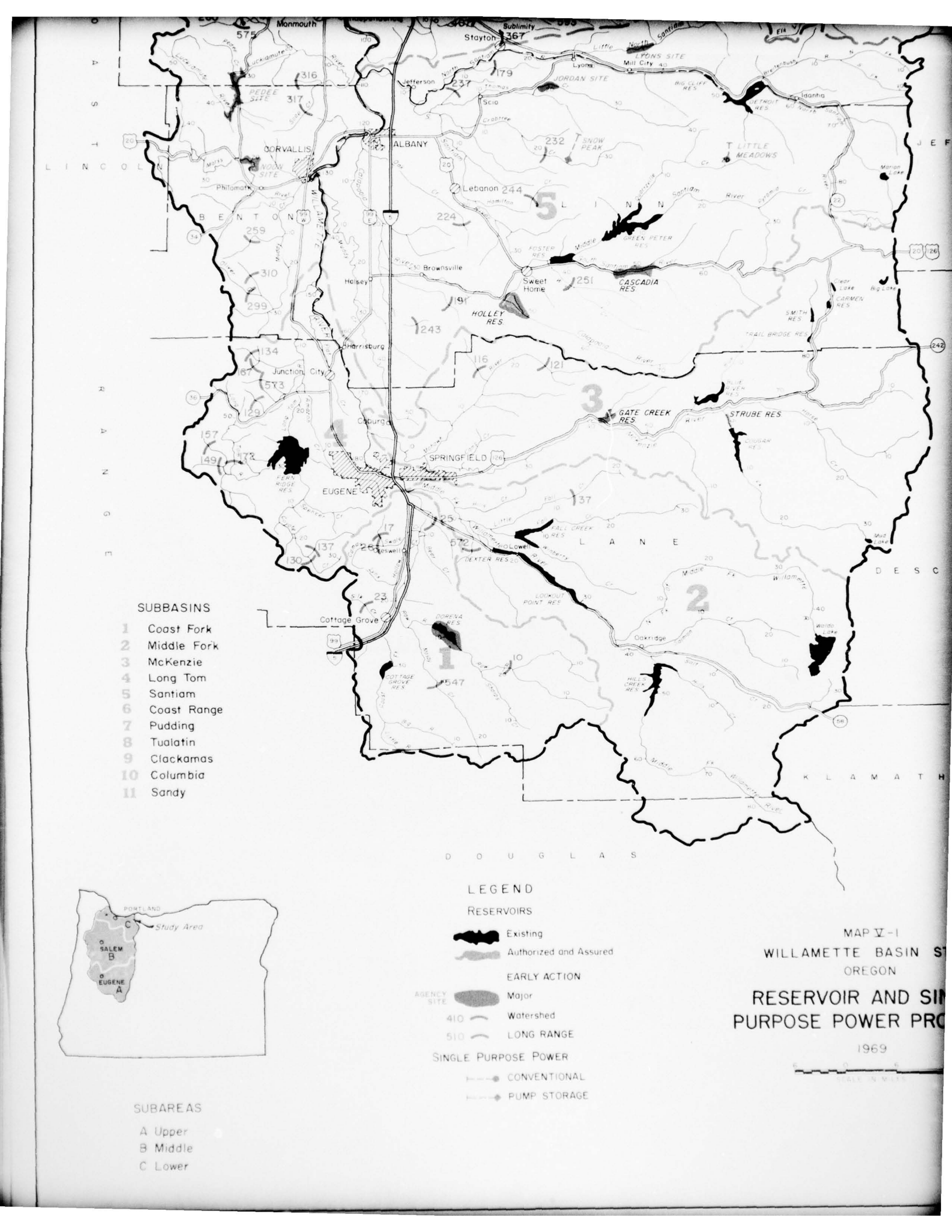
5/ To the extent identified.

PROJECTS, OVERALL

The comprehensive basin plan, in total, includes both storage and nonstorage projects in the categories of existing, authorized, assured, early-action, and long-range. The estimated cost of all projects in the plan is in the order of $4.6 billion, or about 80 percent of the total investment represented by the overall plan. About 10 percent of the total projects cost already has been invested in existing projects, and about an additional four percent will be required for authorized and assured projects. Of the remaining 86 percent, about 15 would be for early-action projects.


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COLUMBIA
WASHINGTON
TILLAMOOK
CLATSKANIE
St Helens
Scappoose
McKAY CREEK RES
Banks
North Plains
EAST FORK DAIRY CREEK SITE
Forest Grove
HILLSBORO
ROCK CREEK RES
Cornelius
Dilley
SCOGGINS RES.
Cherry Grove
Gaston
Laurelwood
PIKE SITE
MOORES VALLEY SITE
Yamhill
Carlton
Dundee
Newberg
Lafayette
YAMHILL
Dayton
McMINNVILLE
GOPHER VALLEY SITE
BICK HOLLOW SITE
Sheridan
Amity
Willamina
SOUTH AGENCY SITE
GORGE SITE
Falls City
Monmouth
Independence
DALLAS
SALEM
Turner
Aumsville
Sublimity
Stayton
Mill City
Lyons
JORDAN SITE
Jefferson
Scio
PEDEE SITE
CORVALLIS
ALBANY
WOOD SITE
Philomath
Lebanon
LINN
BENTON
LINCOLN
Brownsville
Halsey
Sweet Home
CASCADIA RES
HOLLEY RES
Harrisburg
Junction City
SPRINGFIELD
FERN RIDGE RES
GATE CREEK RES
STRUBE RES
JEFFERSON
LITTLE MEADOWS
SNOW PEAK
Idanha
DETROIT RES
BIG CLIFF RES
MARION
Woodburn
Gervais
Mt Angel
Silverton
Hubbard
Aurora
Canby
Molalla
DICKEY BRIDGE SITE
Wilsonville
Tualatin
Sherwood
West Linn
Durham
Tigard
Lake Oswego
Milwaukie
PORTLAND
Troutdale
Fairview
Gresham
MULTNOMAH
HOOD
Boring
Sandy
OREGON CITY
RIVER MILL RES
Estacada
FARADAY RES
CLACKAMAS
COTTONWOOD
SHELLROCK
BULL RUN RES NO 1
BULL RUN RES NO 2
SCHAW MEADOWS
CACHE MEADOWS
BATTLE CREEK
MT.
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11


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PACIFIC NORTHWEST RIVER BASINS COMMISSION
N
COLUMBIA
WASHINGTON
CLACKAMAS
MULTNOMAH
HOOD RIVER
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
JEFFERSON
CROOK
WHEELER
GRANT
DESCHUTES
JOHN DAY
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Lake Oswego
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Tualatin
West Linn
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Sherwood
Yamhill
Carlton
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Lafayette
Dayton
McMINNVILLE
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Sheridan
Willamina
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St Paul
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SALEM
DALLAS
Falls City
Monmouth
Independence
Turner
Aumsville
Sublimity
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ALBANY
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Harrisburg
Junction City
Coburg
Fairview
Troutdale
Gresham
Boring
Sandy
Estacada
Eagle Cr
Timothy Lake
Clackamas River
Molalla River
Santiam River
Willamette River
McKAY CREEK RES
ROCK CREEK RES
SCOGGINS RES
BULL RUN RES NO 1
BULL RUN RES NO 2
RIVER MILL RES
FARADAY RES
CAZADERO RES
NORTH FORK RES
SQUAW MEADOWS
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COTTONWOOD
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DICKEY BRIDGE SITE
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ORANGE SITE
PEDEE SITE
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BIG CLIFF RES
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SNOW PEAK
LITTLE MEADOWS
GREEN PETER RES
FOSTER RES
CASCADIA RES
HOLLEY RES
SMITH RES
TRAIL BRIDGE RES
CARMEN RES
GATE CREEK RES
STRUBE RES
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SUBBASINS
1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy
LEGEND
RESERVOIRS
Existing
Authorized and Assured
EARLY ACTION
AGENCY SITE
Major
Watershed
LONG RANGE
SINGLE PURPOSE POWER
CONVENTIONAL
PUMP STORAGE
SUBAREAS
A Upper
B Middle
C Lower
Study Area
PORTLAND
SALEM
EUGENE
Albany
Corvallis
Lebanon
Sweet Home
Brownsville
Harrisburg
Junction City
Springfield
Eugene
Cottage Grove
Oakridge
Lowell
Lyons
Mill City
Stayton
Sublimity
Scio
Jefferson
Monmouth
Idanha
Detroit
Halsey
Philomath
Coburg
Lorane
Creswell
Marion
Lake
Clear Lake
Big Lake
Mud Lake
Waldo Lake
Green Peter Res
Foster Res
Cascadia Res
Holley Res
Gate Creek Res
Strube Res
Fern Ridge Res
Dexter Res
Lookout Point Res
Dorena Res
Cottage Grove Res
Hills Creek Res
Trail Bridge Res
Smith Res
Carmen Res
Blue River Res
Cougar Res
Big Cliff Res
Detroit Res
Jordan Site
Lyons Site
Pedee Site
Snow Site
Snow Peak
Little Meadows
LINCOLN
BENTON
LINN
MARION
LANE
DOUGLAS
KLAMATH
DESCHUTES
JEFFERSON
CASCADES
COAST RANGE
MAP V-1
WILLAMETTE BASIN ST
OREGON
RESERVOIR AND SI
PURPOSE POWER PRO
1969

SUBBASINS

- Coast Fork
- Middle Fork
- McKenzie
- Long Tom
- Santiam
- Coast Range
- Pudding
- Tualatin
- Clackamas
- Columbia
- Sandy

LEGEND

RESERVOIRS

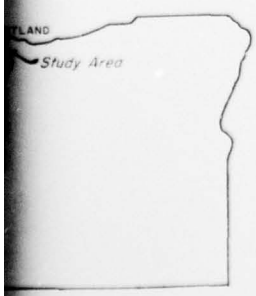
- Existing
- Authorized and Assured

EARLY ACTION

- AGENCY SITE — Major
- 410 — Watershed
- 510 — LONG RANGE

SINGLE PURPOSE POWER

- CONVENTIONAL
- PUMP STORAGE



SUBAREAS

- A Upper
- B Middle
- C Lower

MAP V-1

WILLAMETTE BASIN STUDY

OREGON

RESERVOIR AND SINGLE PURPOSE POWER PROJECTS

1969

The following paragraphs summarize data on storage and nonstorage project elements of the comprehensive plan. Information concerning project studies by agencies is contained in Addendum C. Agency listings therein indicate where additional data and study files are located.

Multiple-purpose Storage Elements

Consistent with basic concepts discussed in Part IV, multiple-purpose storage projects constitute a major segment of the overall plan. Overall, the approximate $1.1-billion cost of storage represents about 19 percent of total plan cost. About 37 percent of the storage investment already has been made; roughly 14 percent would be for authorized and assured storage, leaving 49 percent for proposed new early-action and long-range projects. Map V-1 shows locations and Table V-2 summarizes information on the storage segment of the overall plan. All of the existing, authorized, and assured multiple-purpose storage is in Federal or Federally assisted projects.

Purposes Served by Storage

The storage segment of the plan would be for multiple-purpose uses. The functions involved are fish and wildlife, flood control, irrigation, M&I water supply, navigation, power generation, recreation, and water quality control. Existing multiple-purpose reservoirs, authorized for less than the full range of functions named, would be reauthorized to recognize potentials, and planned operation, for service in all appropriate functional fields.

Project Operation

Federal storage projects would be operated as a system for flood control. Projects not included in system operation would contribute to basin-wide flood control incidental to operation for flood control in the watershed or subbasin involved.

Operating instructions for flood control system operation would continue to be issued from the Portland District Office of the U. S. Army Corps of Engineers. The computer program used in system analysis for this report will provide information on basinwide effects of alternative operational sequences, and thus assist in making flood control operation decisions.

AD-A036 765 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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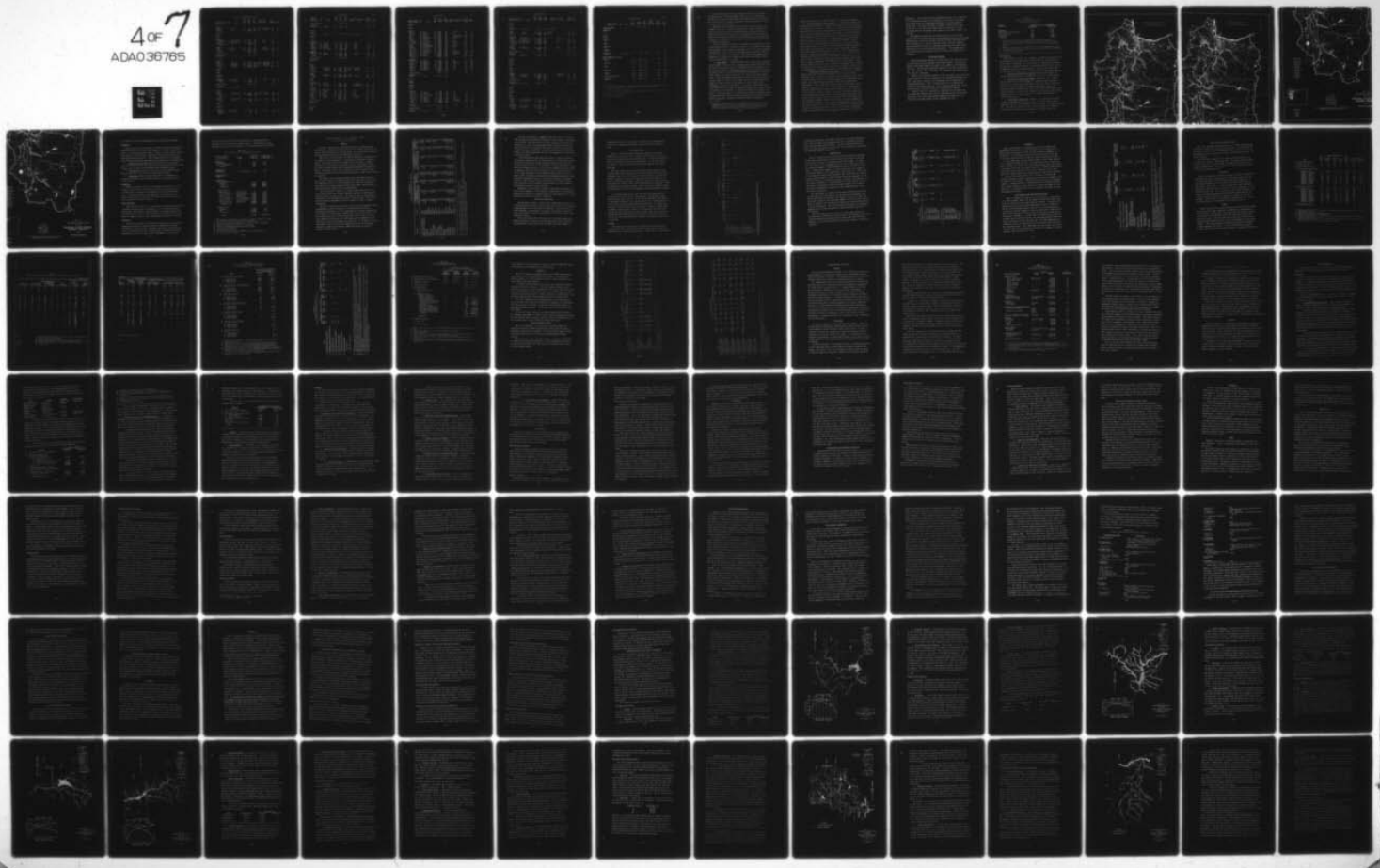


Table V-2

Storage elements of the comprehensive basin plan

Subbasin, Category, and Reservoir Name	Site No.	Stream	Trib. Area, sq. miles	Total Storage, ac.-ft.	Surface Area, acres	Functions to be Served 1/ Auth.	Functions to be Served 1/ New	Construction, $1,000,000	O&M, $1,000
1, Coast Fork									
Existing:									
Cottage Grove		Coast Fork	104	33,000	1,160	FC,N,I	R,F&W,WQ,WS	3.2	91
Dorena		Row R.	265	77,500	1,840	FC,N,I	R,F&W,WQ,WS	14.5	68
Subtotals		-	-	110,500	3,000	-	-	17.7	159
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
N.F. Camas Swale	17	N.F. Camas Swale Cr.	5.8	6,400	270	-	I,O	0.5	1
Camas Swale	26	Camas Swale Cr.	16.7	16,000	800	-	FC,R,O	1.1	4
Cloverdale	25	Trib. Coast Fork	7.5	9,000	330	-	I,R,O	1.3	4
Dorena Modification		Row R.	-	10,000	60	-	FC	0.8	4
Subtotals		-	-	41,400	1,460	-	-	3.7	13
Long-Range:									
Abrams	547	Mosby Cr.	66	50,000	660	-	FC,R,F&W	20.2	N/A
Disston	10	Row R.	124	90,000	950	-	FC,R,F&W,WS	32.2	N/A
Silk Cr.	23	Silk Cr.	10.6	7,900	310	-	FC,I,O	1.6	N/A
Subtotals		-	-	147,900	1,920	-	-	54.0	-
Subbasin Plan Totals		-	-	299,800	6,380	-	-	75.4	N/A
Opportunities:									
Cottage Grove #3	6	Coast Fork	72	40,000	990	-	-	13.2	N/A
2, Middle Fork									
Existing:									
Hills Cr.		Middle Fork	389	356,000	2,735	FC,N,P,I	R,F&W,WQ,WS	45.7	141
Lookout Point		Middle Fork	991	456,000	4,360	FC,N,P,I	R,F&W,WQ,WS)	88.7	512
Dexter		Middle Fork	996	27,500	1,025	P	R,F&W,WQ,WS)		
Fall Cr.		Fall Creek	184	125,000	1,880	FC,N,I	R,F&W,WQ,WS	21.7	109
Subtotals		-	-	964,500	10,000	-	-	156.1	762
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
None		-	-	-	-	-	-	-	-
Long-Range:									
Rattlesnake Cr.	572	Rattlesnake Cr.	2	2,400	60	-	FC,I,O	0.8	N/A
L. Fall Cr.	37	L. Fall Cr.	24	20,400	360	-	FC,O	1.9	N/A
Subtotals		-	-	22,800	420	-	-	2.7	
Subbasin Plan Totals		-	-	987,300	10,420	-	-	158.8	N/A
Opportunities:									
Upper N. Fk.	55	N. Fk. Middle Fk.	136	50,000	640	-	-	17.0	
3, McKenzie									
Existing:									
Cougar		S. Fk. McKenzie R.	208	219,000	1,280	FC,N,P,I	R,F&W,WQ	54.7	224
Blue R.		Blue R.	88	89,000	975	FC,N,I	R,F&W,WQ	30.1	109
Subtotals		-	-	308,000	2,255	-	-	84.8	333
Authorized:									
Strube		S. Fk. McKenzie R.	216	5,900	230	P	-	22.2	80
Gate Cr.		Gate Cr.	50	55,000	605	FC,N,I	R,F&W,WQ	38.3	137
Subtotals		-	-	60,900	835	-	-	60.5	217
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
None		-	-	-	-	-	-	-	-
Long Range:									
Upper Mohawk #2	121	Mohawk R.	18	24,500	275	-	FC,I,O	2.9	N/A
Shotgun Cr.	116	Shotgun Cr.	14.9	12,700	275	-	FC,I,O	1.1	N/A
Subtotals		-	-	37,200	550	-	-	4.0	

Table V-2 (cont'd)

Subbasin, Category, and Reservoir Name	Site No.	Stream	Trib. Area, sq. miles	Total Storage, ac.-ft.	Surface Area, acres	Functions to be Served 1/ Auth.	Functions to be Served 1/ New	Construction $1,000,000	O&M, $1,000
Subbasin Plan Totals		-	-	406,100	3,640	-	-	149.3	N/A
Opportunities:									
Horse Cr.	81	Horse Cr.	136	75,000	640	-	-	33.4	N/A
Foley Ridge	71	McKenzie R.	340	160,000	1,770	-	-	72.8	N/A
4, Long Tom									
Existing:									
Fern Ridge		Long Tom R.	275	117,000	10,400	FC,N,I	R,F&W,WQ,WS	8.4	158
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
Bunker Hill	130	Coyote Cr.	12.1	10,000	410	-	FC,R	1.0	4
Unnamed	137	Fox Hollow	10.5	10,500	320	-	FC,I,O	1.2	4
Bear Cr.	129	Bear Creek	1.7	2,500	110	-	FC,I	0.3	1
Owens Cr.	573	Owens Cr.	4.2	8,200	130	-	FC,I,R	0.9	5
Ferguson Cr.	134	Ferguson Cr.	5.9	6,000	120	-	I,R	0.9	4
Unnamed	167	Trib. Ferguson Cr.	3.2	5,700	130	-	FC,I	0.4	1
Subtotals		-	-	42,900	1,220	-	-	4.7	19
Long-Range:									
Upper Noti	172	Long Tom R.	44	35,000	1,920	-	FC,I,R,F&W	10.8	N/A
Poodle Cr.	157	Poodle Cr.	6.7	14,300	320	-	FC,O	0.9	N/A
Log Pond	149	Elk Cr.	11.2	20,000	720	-	FC,O	1.8	N/A
Subtotals		-	-	69,300	2,960	-	-	13.5	N/A
Subbasin Plan Totals		-	-	229,200	14,580	-	-	26.6	N/A
Opportunities:									
None		-	-	-	-	-	-	-	-
5, Santiam									
Existing:									
Green Peter		M. Santiam R.	277	430,000	3,720	FC,N,P,I	R,F&W,WQ,WS)	82.3	408
Foster		S. Santiam R.	494	61,000	1,220	FC,P	R,F&W,WQ,WS)		
Detroit		N. Santiam R.	438	455,000	3,580	FC,N,P,I	R,F&W,WQ,WS)	62.7	446
Big Cliff		N. Santiam R.	452	5,900	100	P	-)		
Subtotals		-	-	951,900	8,620	-	-	145.0	854
Authorized:									
Holley		Calapooia R.	105	97,000	2,120	FC,N,I	-	23.5	165
Cascadia		S. Santiam R.	179	160,000	1,700	FC,N,I	R,F&W,WQ,WS	54.8	110
Subtotals		-	-	257,000	3,820	-	-	78.3	275
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
Holley Enlargement		Calapooia R.	-	48,000	560	-	R,F&W,WS,WQ	9.5	50
Jordan	203	Thomas Cr.	76	93,000	1,880	-	FC,I,R,F&W,WS,WQ,N	14.8	172
Lyons	241	L. N. Santiam R.	91	110,000	1,500	-	FC,R,F&W,WS,WQ,N	42.0	365
Subtotals		-	-	251,000	3,940	-	-	66.3	587
Long-Range:									
Sucker Slough	237	Sucker Slough	4.7	7,200	395	-	FC,O	0.8	N/A
Courtney Cr.	191	Courtney Cr.	8.8	6,400	160	-	FC,O	1.4	N/A
L. Muddy Cr.	243	L. Muddy Cr.	2.2	3,400	90	-	FC,O	0.6	N/A
Bear Br.	179	Bear Br.	10.6	16,800	490	-	FC,O	1.2	N/A
Oak Cr.	224	Oak Cr.	4.8	7,200	180	-	FC,O	1.0	N/A
Hamilton Cr.	244	Hamilton Cr.	16.6	12,000	330	-	FC,O	1.3	N/A
Wiley Cr.	251	Wiley Cr.	51	65,000	1,275	-	FC,F&W,R,WQ	18.7	N/A
Sawmill	232	Crabtree Cr.	66	70,000	620	-	FC,F&W,WQ,P	32.9	N/A
Subtotals		-	-	188,000	3,540	-	-	57.9	
Subbasin Plan Totals		-	-	1,647,900	19,920	-	-	347.5	N/A
Opportunities:									
None		-	-	-	-	-	-	-	-
6, Coast Range									
Existing:									
None		-	-	-	-	-	-	-	-

Table V-2 (cont'd)

Subbasin, Category, and Reservoir Name	Site No.	Stream	Trib. Area sq. miles	Total Storage, ac.-ft.	Surface Area, acres	Functions to be Served 1/ Auth.	Functions to be Served 1/ New	Construction $1,000,000	O&M, $1,000
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
Gorge	281	Mill Cr.	31	53,000	560	-	FC,I,R,F&W	19.3	28
Beaver Cr.	259	Beaver Cr.	10.7	13,000	340	-	I	1.1	5
Oliver Cr.	299	Oliver Cr.	13.0	9,600	260	-	FC,R	1.2	15
Reese Cr.	310	Reese Cr.	6.1	9,600	320	-	I	0.6	3
Noon	574	Marys R.	97	115,000	1,725	-	FC,I,R,F&W,WS,WQ	26.4	274
Pedee	302	Luckiamute R.	115	130,000	3,700	-	FC,I,R,F&W,WQ	28.6	278
Black Rock	260	L. Luckiamute R.	20.4	6,000	160	-	FC	0.7	2
Teal Cr.	550	Teal Cr.	13.0	25,000	510	-	I,R,WS,O	2.3	9
Staats Cr.	316	Staats Cr.	2.1	3,600	210	-	I	0.7	2
M. F. Ash Cr.	291	M. F. Ash Cr.	2.4	3,000	190	-	FC,R	0.5	1
N. F. Ash Cr.	296	N. F. Ash Cr.	2.5	3,100	120	-	FC,O	0.5	1
Moores Valley	292	Haskins Cr.	15	30,000	700	-)	FC,I,R,F&W	5.4	79
Pike	306	N. Yamhill R.	66	75,000	1,200	-)		16.5	110
Unnamed	578	Trib. Chehalem Cr.	1.7	2,400	80	-	FC,I,O	0.5	5
Unnamed	581	Trib. Chehalem Cr.	1.5	2,300	130	-	FC,I,O	0.3	2
Palmer Cr.	300	Palmer Cr.	33	11,550	690	-	I,R	1.4	5
W. F. Salt Cr.	577	W. F. Salt Cr.	4.4	9,500	140	-	I,R,O	1.6	6
Salt Cr.	558	Salt Cr.	46.3	8,400	680	-	I	0.9	4
Spring Valley	315	Spring Valley Cr.	3.5	4,800	200	-	I	0.7	2
Agency	253	S. Yamhill R.	64	78,000	2,520	-	FC,I,R,F&W	20.3	243
Buck Hollow	261	Willamina Cr.	61	84,000	1,120	-	FC,I,R,F&W	16.3	130
Gopher Valley	269	Deer Cr.	22	33,000	915	-	FC,I,R,F&W	7.0	91
Deer Cr.) 2/	269	Deer Cr.		18,000	700	-	I,O	1.0	5
Muddy Cr.) 2/	293	Muddy Cr.	12.3	18,400	600	-	R,O	1.8	16
Subtotals 3/		-	-	709,850	16,470	-	-	152.8	1,295
Long-Range:									
Sulphur Spring	317	Soap Cr.	10	13,000	320	-	FC,O	1.3	N/A
Salt Cr.	576	Salt Cr.	3.3	3,600	135	-	FC,O	0.4	N/A
Spring Brook	580	Spring Br.	5.3	2,640	150	-	R,O	0.4	N/A
Dallas	268	Rickreall Cr.	31	30,000	420	-	FC,F&W,R,WQ	11.1	N/A
Rowell Cr.	584	Rowell Cr.	12.3	26,700	380	-	FC,O	3.1	N/A
Grant Cr.	575	Grant Cr.	3.0	5,500	150	-	I	0.5	N/A
Panther Cr.	301	Panther Cr.	12.3	19,500	340	-	FC,O	1.6	N/A
Baker Cr.	256	Baker Cr.	14.8	14,600	340	-	FC,O	1.1	N/A
Tindle Cr.	318	Tindle Cr.	5.8	11,700	270	-	FC,O	1.4	N/A
Ead Cr.	585	Ead Cr.	4.5	11,700	180	-	FC,O	2.1	N/A
Subtotals		-	-	138,940	2,685	-	-	23.0	-
Subbasin Plan Totals 3/		-	-	848,790	19,155	-	-	175.8	N/A
Opportunities:									
Summit	327	Marys R.	15.8	25,000	1,080	-	-	1.8	N/A
7, Pudding									
Existing:									
None		-	-	-	-	-	-	-	-
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
Beaver Cr.	337	Beaver Cr.	3.3	5,700	190	-	R,O	1.1	7
Coal Cr.	586	Coal Cr.	7.1	15,600	300	-	I	1.0	3
Drift Cr.	410	Drift Cr.	15.5	9,000	310	-	I,O	0.5	1
S. F. Pudding R.	350	S. F. Pudding R.	4.5	5,200	260	-	I,R,O	1.0	4
Battle Cr.	358	Battle Cr.	5.5	2,700	100	-	R,O	0.4	1
Mill Cr.	367	Mill Cr.	10.5	5,950	250	-	FC,O	0.9	3
Beaver Cr.	407	Beaver Cr.	21.1	21,200	1,000	-	FC,R	2.2	4
Dickey Bridge	348	Molalla R.	204	273,000	2,650	-	FC,I,R,F&W	56.1	351
Grange	352	Silver Cr.	40	80,000	680	-	FC,I,R,F&W	16.8	83
Selah	386	Pudding R.	59	22,000	1,400	-	FC,I,R,F&W	7.9	135
Subtotals		-	-	440,350	7,140	-	-	87.9	592
Long-Range:									
S. F. Silver Cr.	593	S. F. Silver Cr.	10.9	24,600	510	-	R,FC,O	2.6	N/A
Subbasin Plan Totals		-	-	464,950	7,650	-	-	90.5	N/A
Opportunities:									
Coal Cr.	569	Butte Cr.	35	40,000	525	-	-	14.0	N/A

Subbasin, Category, and Reservoir Name	Site No.	Stream	Trib. Area, sq. miles	Total Storage, ac.-ft.	Surface Area, acres	Functions to be Served 1/ Auth.	New	Construction $1,000,000	O&M, $1,000
8, Tualatin									
Existing:									
None		-	-	-	-	-	-	-	-
Authorized:									
Scoggins	427	Scoggins Cr.	39	59,200	1,113	FC,I,R,F&W,WS,WQ	-	9.3	44
Assured:									
McKay Cr.		McKay Cr.	23.5	21,500	310	FC,I,R,WS	-	3.8	86
Rock Cr.		Rock Cr.	19	11,000	700	FC,I,R	-	2.4	85
Subtotals		-	-	32,500	1,010	-	-	6.2	171
Early-Action:									
Tolke Canyon	435	Witcher Cr.	3.3	6,100	120	-	I,R	1.2	6
Unnamed	449	Trib. W.Fk. Dairy Cr.	4.8	8,100	170	-	I,O	1.4	4
Gaston	422	Tualatin R.	52	68,000	1,720	-	) FC,I,R,F&W,WS,WQ	15.9	148
E.Fk. Dairy Cr.	417	E. Fk. Dairy Cr.	42	47,000	1,030	-	)	15.4	112
Bledsoe Cr.)	438	Bledsoe Cr.	5.2	8,000	370	-	R,O	1.3	6
E.Fk. Dairy Cr.) 4/	440	E. Fk. Dairy Cr.	24.9	10,000	180	-	I,O	1.3	4
Subtotals 3/		-	-	129,200	3,040	-	-	33.9	270
Long-Range:									
Gales Cr.	441	Gales Cr.	13.7	14,500	240	-	FC,O	1.2	N/A
McFee Creek	443	McFee Creek	9.4	12,500	210	-	FC,O	1.8	N/A
Subtotals		-	-	27,000	450	-	-	3.0	
Subbasin Plan Totals 3/		-	-	247,900	5,613	-	-	52.4	N/A
Opportunities:									
Glenwood	423	Gales Cr.	34	40,000	850	-	-	10.2	N/A
Gales Cr.	420	Gales Cr.	65	60,000	1,500	-	-	14.4	N/A
9, Clackamas									
Existing:									
None		-	-	-	-	-	-	-	-
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
None		-	-	-	-	-	-	-	-
Long-Range:									
Big Bottom	451	Clackamas R.	139	120,000	1,660	-	FC,F&W,R,WQ,WS	14.4	N/A
Clear Cr.	467	Clear Cr.	63	60,000	1,400	-	FC,F&W,R,WQ,WS	6.0	N/A
Eagle Cr.	497	Eagle Cr.	28	21,000	300	-	FC,O	2.3	N/A
Subtotals		-	-	201,000	3,360	-	-	22.7	N/A
Subbasin Plan Totals		-	-	201,000	3,360	-	-	22.7	N/A
Opportunities:									
Upper Austin Point	507	Collawash R.	152	180,000	1,700	-	-	20.2	N/A
10, Columbia									
Existing:									
None		-	-	-	-	-	-	-	-
Authorized:									
None		-	-	-	-	-	-	-	-
Assured:									
None		-	-	-	-	-	-	-	-
Early-Action:									
Unnamed	515	Trib. Johnson Cr.	3.8	3,260	180	-	FC,R	0.8	2
Unnamed	591	Trib. Johnson Cr.	4.1	1,080	100	-	FC	1.0	1
Unnamed	592	Johnson Cr.	3.8	1,010	80	-	FC	0.4	1
Subtotals		-	-	5,350	360	-	-	2.2	4
Long-Range:									
N. Scappoose Cr.	513	N. Scappoose Cr.	18	18,200	540	-	FC,O	1.7	N/A
Milton Cr.	510	Milton Cr.	9.2	10,000	300	-	FC,O	0.7	N/A
Fairview Lake	566	Fairview Cr.	6.3	1,740	200	-	R,O	0.4	N/A
Subtotals		-	-	29,940	1,040	-	-	2.8	N/A

Table V-2 (cont'd)

Subbasin, Category, and Reservoir Name	Site No.	Stream	Trib. Area, sq.miles	Total Storage, ac.-ft.	Surface Area, acres	Functions to be Served 1/ Auth.	Functions to be Served 1/ New	Construction $1,000,000	O&M, $1,000
Subbasin Plan Totals		-	-	35,290	1,400	-	-	5.0	N/A
Opportunities: None		-	-	-	-	-	-	-	-
11, Sandy									
Existing: None		-	-	-	-	-	-	-	-
Authorized: None		-	-	-	-	-	-	-	-
Assured: None		-	-	-	-	-	-	-	-
Early-Action: None		-	-	-	-	-	-	-	-
Long-Range: None		-	-	-	-	-	-	-	-
Opportunities: Linney	526	Salmon R.	54	40,000	500	-	-	18.2	N/A
Summary, Willamette Basin Study Area									
Existing: 13		-	3,066 5/	2,451,900	34,275	-	-	412.0	2,266
Authorized: 5		-	202 5/	377,100	5,770	-	-	148.1	536
Assured: 2		-	43	32,500	1,010	-	-	6.2	171
Early-Action 3/: 52		-	1,289 5/	1,620,050	33,630	-	-	351.5	2,780
Long-Range: 37		-	682 5/	886,680	17,435	-	-	186.2	N/A
Comprehensive Plan Totals 3/:		-	5,282 5/	5,368,230	92,120	-	-	1,104.0	N/A
Opportunities: 10		-	761 5/	710,000	10,195	-	-	215.2	N/A

N/A Not available.

1/ FC = Flood Control; N = Navigation; I = Irrigation; P = Power; R = Recreation; F&W = Fish and Wildlife; WS = Water Supply; WQ = Water Quality Control; O = Space not assigned, but available for other purposes.

2/ Alternative to Gopher Valley, site No. 269.

3/ Based on single major storage projects in lieu of multiple-storage watershed alternatives (in subbasins 6 and 8).

4/ Alternative to E. Fk. Dairy Cr., site No. 417.

5/ Adjusted to eliminate duplication.

The system-operation plan also would be utilized to facilitate the satisfaction of multiple-purpose needs for use of stored water. Flexibility of operation would permit variations necessary to make best use, in each year, of storage available in individual projects to meet at-project and overall needs.

USBR would furnish information on amounts of stored water to be released from Corps of Engineers reservoirs to satisfy irrigation contracts, and on the location of diversion points under each contract. Flow needs data would be provided, in coordination with water quality, fishery, and recreation agencies, for consideration in conjunction with irrigation and navigation needs and municipal and industrial water supply contract commitments.

The basic operational pattern for storage system operation to serve flood control and water conservation needs in all functional fields would take advantage of the seasonal precipitation and runoff pattern discussed in Appendix B. Thus, joint use of storage space for multiple purposes would be both possible and practical. That operational pattern may be summarized, in general, in a three-season annual operational sequence for major reservoirs[1/] as follows:

a. Flood season. - During the winter major flood season, generally about November 15 to February 1, storage space assigned for flood control use would be kept empty except as filling might occur incidental to control of flood runoff. For existing Federal, and for some new, projects, the space required for flood control would be substantially all of the usable space; for others, it would be only a part of the total usable space. Thus, some reservoirs may have to be drawn down specifically to evacuate space for flood control; others may be at a lower level than needed for flood control, and be subject to some filling at the beginning of the major flood season. In any case, flood control operation would entail a sequence of temporary storage of floodflows followed by evacuation of stored water to restore scheduled flood control capability. Evacuation should be accomplished as rapidly as possible consistent with available channel capacity downstream; the basin-wide system of channel improvement subsequently discussed would be designed in

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1/ *Reservoirs which are elements of watershed projects under Public Law 566 would be operated on a generally similar basis, but with emphasis on meeting watershed needs; basinwide effects generally would be incidental to operation to meet watershed needs.*

consideration of needs for channel capacity for reservoir evacuation.

b. Water conservation storage season. - As the annual runoff cycle progresses from conditions of excessive to nominal surface water supply, the potential for flooding is reduced. Thus, the amount of storage space reserved for flood control may be reduced by storage of water for other uses. The water conservation pattern used to date for existing Federal multiple-purpose reservoirs has been one of filling most of the flood control space in each reservoir at a uniform rate from about February 1 until about May 15 in each year. In most major reservoirs, a small amount of space would be reserved, unfilled, for control of possible minor summer floods. That pattern has been generally adequate, except in the case of low-elevation reservoirs such as Fern Ridge, Cottage Grove, and Dorena, where problems of inability to fill completely have occurred. However, as discussed briefly in (1) Part V text on Fern Ridge and on Early-Action Effects and Impacts, Flood Control, and (2) Part VI text on Functional Considerations, Flood Control, further study must be given to developing a modified system filling schedule. Such a schedule might involve more rapid filling at the beginning of the season, or perhaps in some cases earlier initiation of filling, in order to be more responsive to the additional needs for stored water now recognized.

c. Conservation storage release season. - During the dry summer months there will be conflicting demands for use of stored water. Functions such as irrigation, navigation, power generation, water quality control, fish and wildlife enhancement, municipal and industrial water supply, and stream recreation would be benefited by withdrawal of stored water. On the other hand, functions and considerations such as reservoir recreation, reservoir fishery, waterfowl use, and overall project esthetics would be benefited by retention of a full reservoir at each project. Based on studies to date, by individual agencies and for this multiagency report, the overall operating schedule generally should be one of making releases as necessary to meet downstream needs for increased streamflow and for water for out-of-stream consumptive and nonconsumptive uses. In one case, Fern Ridge Reservoir, the pressing need for retention of near-full-pool conditions for recreation would be met by developing alternative sources of the presently authorized service to downstream needs for irrigation, navigation, and fish life

maintenance. Under such an overall operating schedule, all or some part of the evacuation necessary to be prepared for the onset of the major flood season would be accomplished incidental to meeting needs for stored water. Any water remaining in storage in flood control space at the end of the conservation season would be evacuated at a rate consistent with the increasing flood potential after about October 1 in each year.

The computer programs used for system analysis for this report would be used for further analysis of the basinwide effects of alternative modifications of the basic seasonal operation sequence described above. Those programs, with a finally selected seasonal operation sequence, also would provide a basis for individual operational decisions during each portion of the annual operational sequence. The programs are on file with the Corps of Engineers and are available for study and use by others.

Nonstorage Elements

Nonstorage elements consist of all portions of the plan other than the previously discussed programs and storage elements. Services rendered by nonstorage elements are shown in the summary at the beginning of Part V. The principal nonstorage elements of the plan are those for: (1) flood control, (2) irrigation, (3) navigation, (4) power generation, and (5) recreation.

Overall, the nonstorage elements of the plan would cost in the order of $3.5 billion, or about 61 percent of total comprehensive basin plan cost. Less than 1 percent of the nonstorage cost is represented by existing development. About 1 percent would be for construction of authorized and assured projects. Of the remaining 98 percent, for new projects, about 10 percent would be for early-action elements.

Tables V-3 and V-4, respectively, summarize cost and other data for nonstorage elements other than for power generation, and for power generation. The following paragraphs summarize information on all principal nonstorage elements of the comprehensive plan.

Table V-3
Nonstorage projects other than for power generation

Category	Estimated Costs, $1,000,000	
	Investment	Annual O&M
Existing	29	0.84
Authorized and assured 1/	37	0.20
Early-action 2/	343	3.59
Long-range	220	N/A
Totals	629	4.63 3/

1/ Does not reflect Corps of Engineers flood control channel authorizations for projects which have been deferred or declared inactive, or which may be constructed outside of current authorizations.
2/ Based on major project development in lieu of watershed alternatives in Subbasins 6 and 8; local choice required between those alternatives.
3/ To the extent identified.

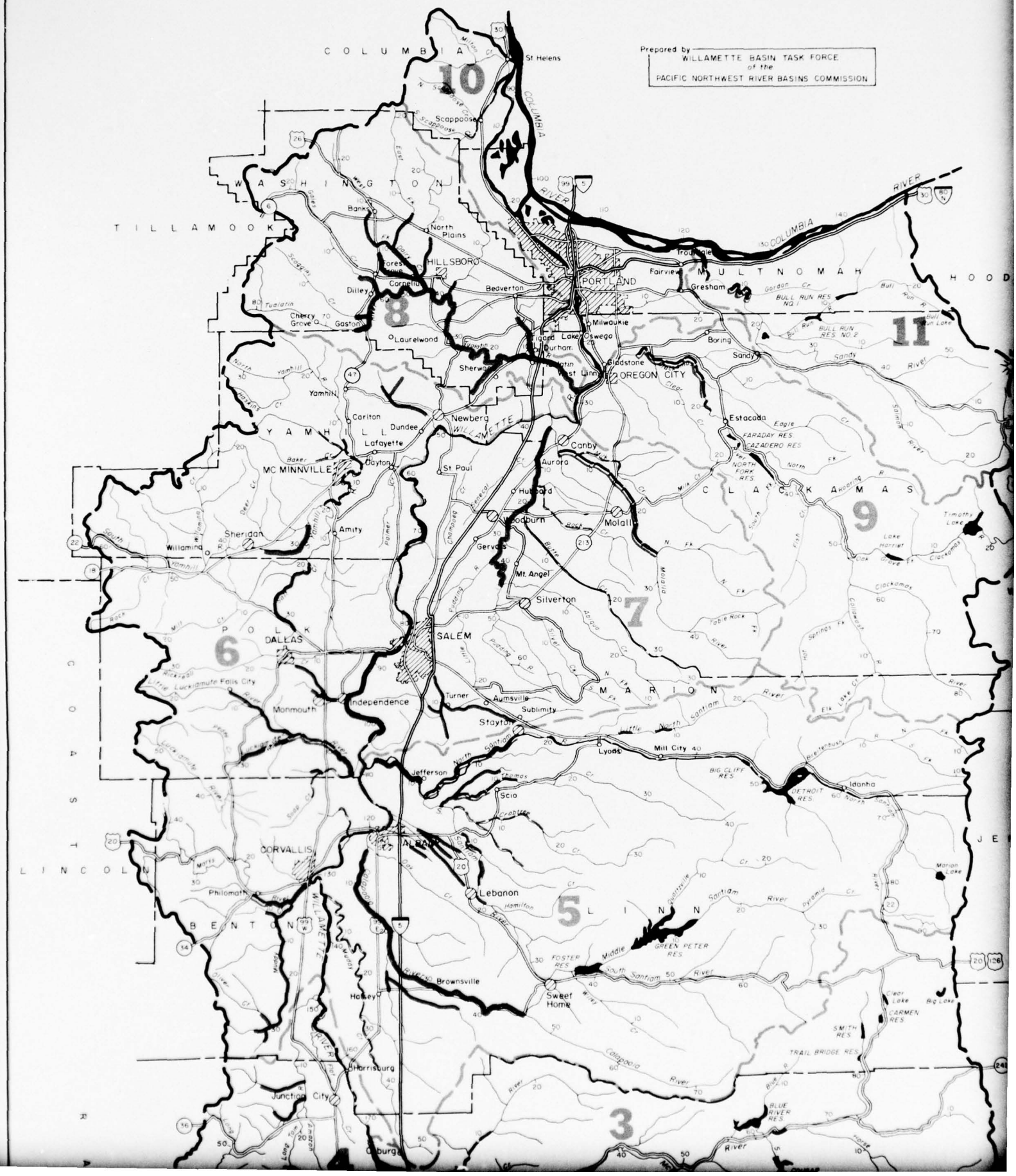
Flood Control

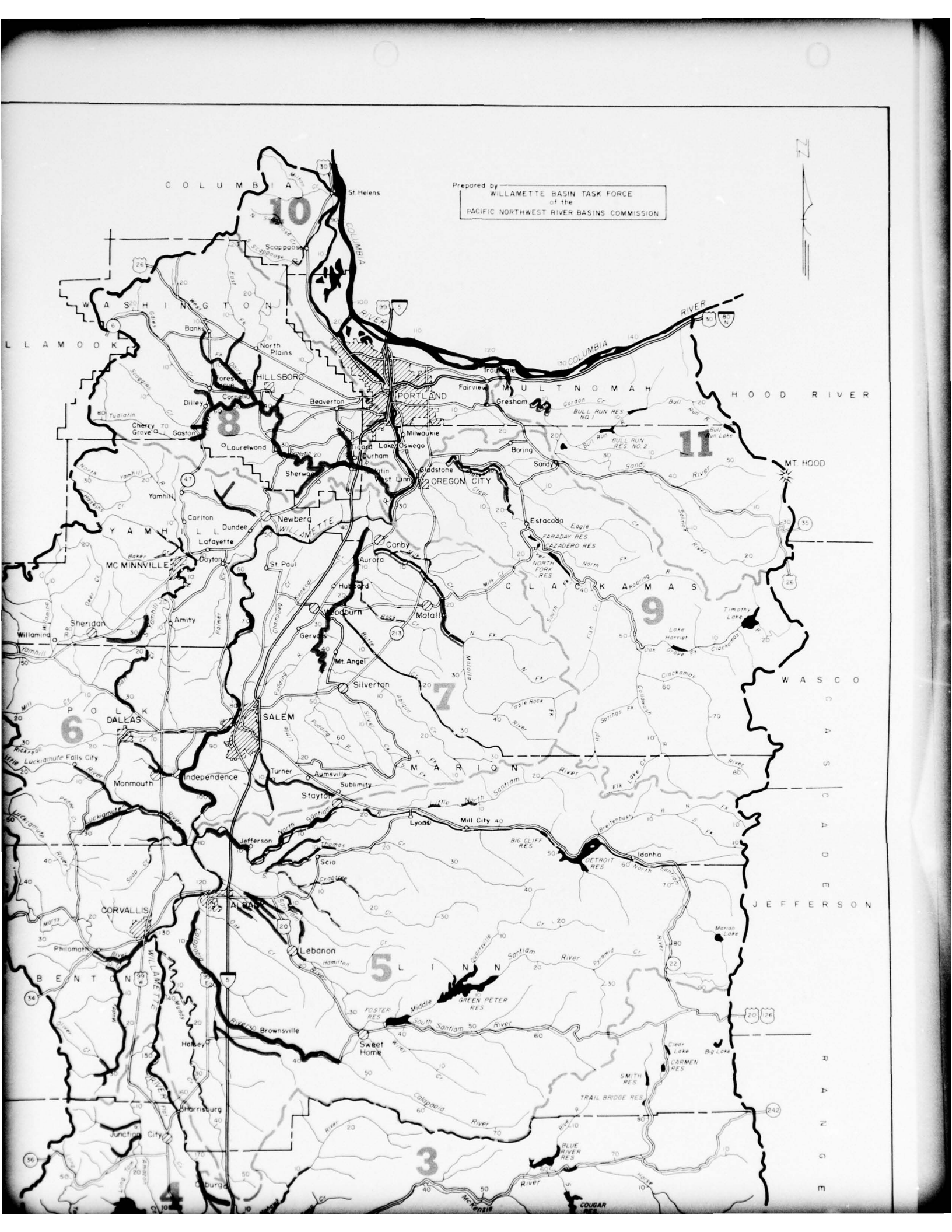
These elements include: (1) existing, authorized, and assured channel improvements and channel stabilization works; (2) potential early-action channel improvement, both as an adjunct to operation of storage projects and as separately planned and justified works; and (3) additional long-range channel stabilization works. Map V-2 shows the general locations and approximate extent of early-action and long-range channels.

a. Existing, authorized, and assured channel improvements and channel stabilization works are summarized in Part II of this appendix.

b. Early-action channel improvement consists of: (1) channel work for flood control and drainage in 17 potential small watershed projects; (2) major channel improvements for flood control, with associated recreation development, on Pudding and Tualatin Rivers; (3) a basin-wide system of channel improvement and channel stabilization, as an essential adjunct to flood control operation of multiple-purpose storage projects; and (4) a separate project for channel stabilization on uncontrolled streams.

c. Long-range channel works include: (1) additional watershed channel improvements in 10 subbasins; (2) a separate major channel improvement project, with possible recreation aspects, in Yamhill Subbasin; (3) additional basin-system channel works, as needed to accommodate flood control operation of the expanded major storage system; and

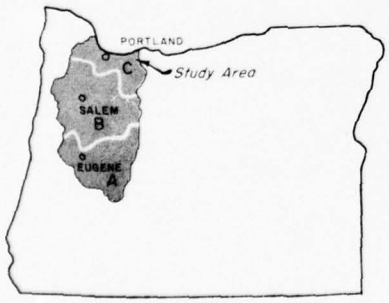

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WILLAMETTE BASIN TASK FORCE
of the
PACIFIC NORTHWEST RIVER BASINS COMMISSION
COLUMBIA
WASHINGTON
TILLAMOOK
YAMHILL
POLK
MARION
LINCOLN
BENTON
LINN
CLACKAMAS
MULTNOMAH
HOOD
St Helens
Scappoose
Banks
North Plains
HILLSBORO
Forest Grove
Cornelius
Dilley
Cherry Grove
Gaston
Laurelwood
Beaverton
PORTLAND
Fairview
Troutdale
Gresham
Milwaukie
Oswego
Lake Grove
Durham
Tigard
Sherwood
West Linn
OREGON CITY
Boring
Sandy
Gladstone
Estacada
Yamhill
Carlton
Newberg
Dundee
Lafayette
Dayton
MC MINNVILLE
Amity
Sheridan
Willamina
St Paul
Aurora
Canby
Hubbard
Woodburn
Molalla
Gervais
Mt. Angel
Silverton
SALEM
DALLAS
Falls City
Monmouth
Independence
Turner
Aumsville
Sublimity
Stayton
Lyons
Mill City
Jefferson
Scio
Idanha
CORVALLIS
ALBANY
Philomath
Lebanon
Brownsville
Halsey
Sweet Home
Harrisburg
Junction City
Coburg
Columbia River
Willamette River
Santiam River
Clackamas River
Pudding R.
Yamhill R.
Molalla R.
Clear Lake
Big Lake
Marion Lake
Timothy Lake
Lake Harriet
Table Rock
Hot Springs
Elk Lake
Bull Run Lake
Bull Run Res. No. 1
Bull Run Res. No. 2
Faraday Res.
Cazadero Res.
North Fork Res.
Detroit Res.
Big Cliff Res.
Foster Res.
Green Peter Res.
Smith Res.
Trail Bridge Res.
Carmen Res.
Blue River Res.
10
8
11
9
7
6
5
3


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COLUMBIA
WASHINGTON
CLATSOP
TILLAMOOK
HOOD RIVER
WASCO
SHERMAN
GILLIAM
MORROW
UMATILLA
JEFFERSON
CROOK
DESCHUTES
KLICKITAT
YAMHILL
POLK
MARION
LINN
BENTON
LINCOLN
LANE
DOUGLAS
CURRY
JOSEPHINE
JACKSON
KLAMATH
LAKE
10
8
11
6
9
7
5
3
4
St. Helens
Scappoose
Banks
North Plains
HILLSBORO
Forest Grove
Cornelius
Dilley
Beaverton
PORTLAND
Fairview
Troutdale
Gresham
Cherry Grove
Gaston
Laurelwood
Tigard
Lake Oswego
Milwaukie
Durham
Tualatin
Sherwood
West Linn
OREGON CITY
Boring
Sandy
MT. HOOD
Yamhill
Carlton
Newberg
Dundee
Lafayette
Dayton
MC MINNVILLE
Estacada
Eagle
FARADAY RES.
CAZADERO RES.
NORTH FORK RES.
Canby
Aurora
St. Paul
Hubbard
Woodburn
Molalla
CLACKAMAS
Timothy Lake
Lake Harriet
Sheridan
Willamina
Amity
Gervais
Mt. Angel
Silverton
SALEM
DALLAS
Luckiamute
Falls City
Monmouth
Independence
Turner
Aumsville
Sublimity
Stayton
MARION
Lyons
Mill City
Jefferson
Scio
BIG CLIFF RES.
DETROIT RES.
Idanha
Marion Lake
CORVALLIS
ALBANY
Philomath
Lebanon
Hamilton
Brownsville
Halsey
Sweet Home
FOSTER RES.
GREEN PETER RES.
Middle
South Santiam
River
Clear Lake
Big Lake
CARMEN RES.
SMITH RES.
TRAIL BRIDGE RES.
Harrisburg
Junction City
Cottage Grove
Coburg
BLUE RIVER RES.
COUGAR RES.
McKenzie
Willamette
Columbia
Santiam
Clackamas
Sandy
Salmon
Bull Run
Bull Run Lake
BULL RUN RES. NO. 1
BULL RUN RES. NO. 2
Gordon Cr.
Eagle Cr.
Clear Cr.
Table Rock Fk.
Hot Springs Fk.
Elk Lake Cr.
Pretenbush
Thomas Cr.
Crabtree
Pyramid Cr.
Gladstone
Tualatin
Yamhill
Baker
Deer Cr.
Palmer
Champoeg
Pudding
Abiqua
Silver
Butte
Molalla
Fishtrap Cr.
Oak Grove Fk.
Clackamas
Hot Springs Fk.
Mill
Rickreall
Little Luckiamute
Soap Cr.
Marys
Oak
Calapooia
Hamilton
Quartzville
Pyramid Cr.
Blue
Horse
Cougar Res.



SUBBASINS

1 Coast Fork
2 Middle Fork
3 McKenzie
4 Long Tom
5 Santiam
6 Coast Range
7 Pudding
8 Tualatin
9 Clackamas
10 Columbia
11 Sandy



SUBAREAS

A Upper
B Middle
C Lower

LEGEND

MAJOR CHANNELS
Early Action
Long Range

MINOR CHANNELS
Early Action
Long Range

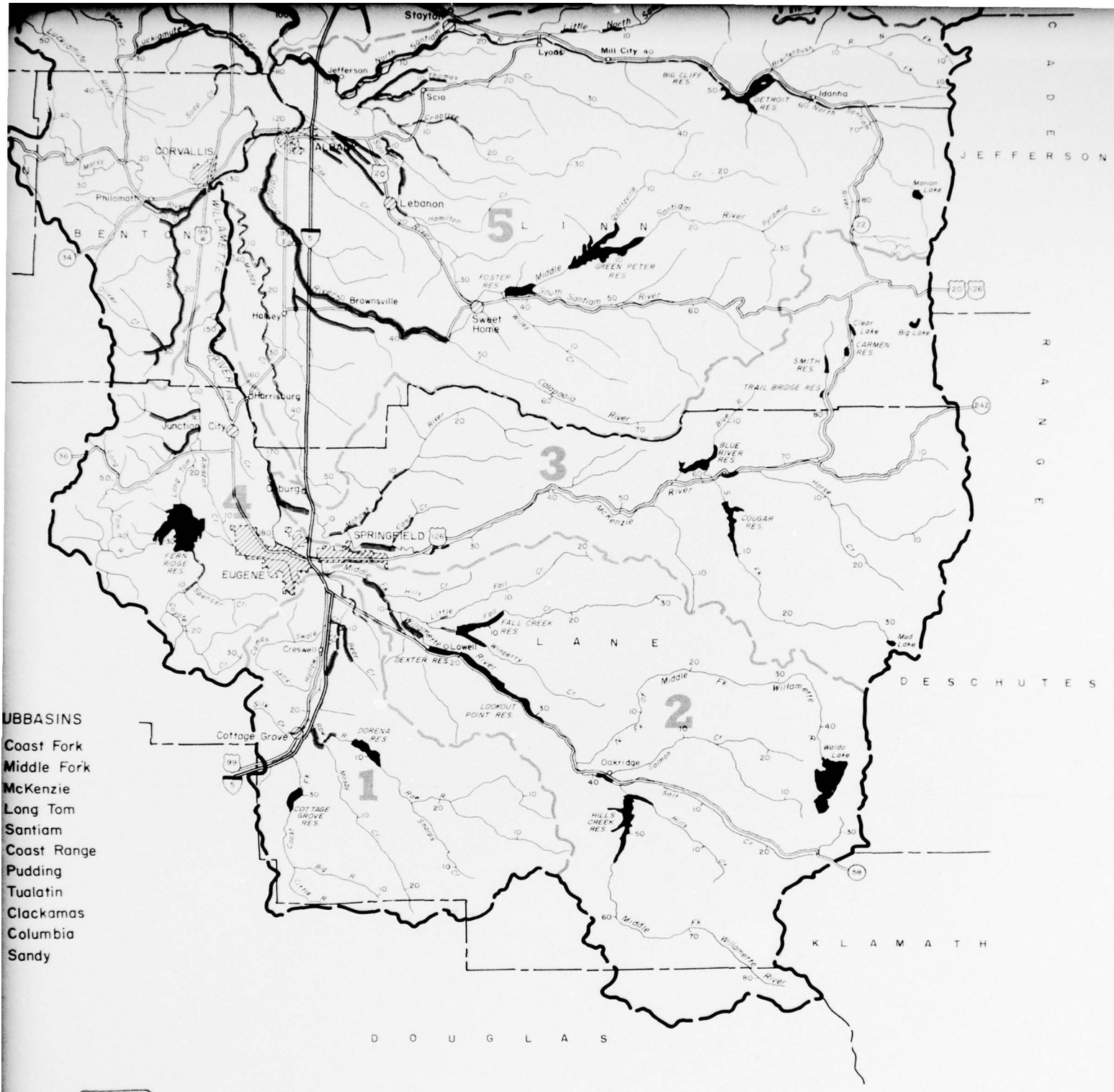
Note: Channel works are not continuous – symbols represent only general reaches including improvements.

MAP V-2
WILLAMETTE BASIN
OREGON

PRINCIPAL FLOOD C
CHANNEL PROJE

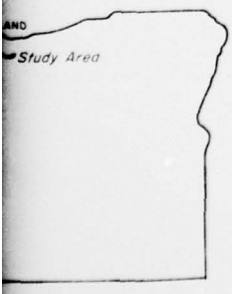
1969

6 0 6
SCALE IN MILES



SUBBASINS

- Coast Fork
- Middle Fork
- McKenzie
- Long Tom
- Santiam
- Coast Range
- Pudding
- Tualatin
- Clackamas
- Columbia
- Sandy



SUBAREAS

- Upper
- Middle
- Lower

LEGEND

MAJOR CHANNELS

- Early Action
- Long Range

MINOR CHANNELS

- Early Action
- Long Range

Note: Channel works are not continuous – symbols represent only general reaches including improvements.

MAP V-2

WILLAMETTE BASIN STUDY

OREGON

PRINCIPAL FLOOD CONTROL CHANNEL PROJECTS

1969

6 0 6 12

SCALE IN MILES

(4) additional channel stabilization works on uncontrolled streams.

Irrigation

These elements are those portions of Federal and Federally-assisted projects which are for diversion (or pumping), conveyance, and distribution of the irrigation water supply. Sources of supply include natural flows and water from existing, authorized, assured, early-action, and long-range storage reservoirs. Total acreage expected to be irrigated under Federal and Federally-assisted projects would be about 549,000 acres.

a. Authorized and assured elements include those in the authorized USBR Tualatin Project, the authorized SCS Amazon-Flat Creek Watershed Project, and the assured SCS McKay-Rock Creek Watershed Project.

b. Early-action elements are those in the seven potential USBR projects and those in 20 potential SCS watershed projects.

c. Long-range elements include extensions and enlargements of authorized and early-action elements as well as a considerable number of new projects.

Navigation

Navigation elements consist of open-channel works which, as a supplement to increased low-water flows, would provide increased depths for navigation in Willamette River upstream to the Corvallis-Albany area. No long-range additions are identified at the present time. No separate map coverage is provided; the approximate upstream terminus may be identified on Maps V-1 and V-2.

Power Generation

These elements include: (1) the existing and authorized facilities, at Federal and non-Federal installations; (2) potential long-range conventional hydroelectric, nuclear-thermal, and pumped-storage peaking installations. Map V-1 shows locations of hydroelectric plants and Table V-4 summarizes data on the power-generation elements of the plan.

Recreation

Included, in addition to recreation at new projects and separately summarized programs for recreation, would be additional recreation development at existing Corps of Engineers reservoirs, and new development at authorized reservoirs. Existing Corps of Engineers recreation installations would be expanded by new development at a cost in the

order of $14 million during the early-action and long-range periods. Existing project locations are shown of Map V-1. Distribution of costs among those projects will be detailed in a subsequent report by the Corps.

Table V-4
Power generation in the comprehensive plan

Project Category and Name	Stream	Installed Cap. mw	Invest. Costs, $1,000,000
Existing:			
All Federal 1/	2/	408	N/A
All Non-Federal 3/		530	N/A
Subtotals		938	-
Authorized:			
Federal 1/	S. Fk. Mckenzie R.	40	N/A
Early-action:			
None		-	-
Long-range:			
Nuclear-thermal: 4/			
Subbasin 4		1,000	200.0
Subbasin 5		1,000	200.0
Subtotals		2,000	400.0
Hydroelectric:			
Shellrock 5/	Oak Grove Fk.	35	7.5
Little Meadow 6/	Quartzville Cr.	1,000	123.0
Snow Peak 6/	Crabtree Cr.	4,000	449.0
Battle Creek 6/	Elk Lake Cr.	6,000	710.0
Cache Meadow 6/	S. Fk. Roaring R.	4,000	462.0
Cottonwood 6/	Oak Grove Fk.	6,000	510.0
Squaw Meadow 6/	Roaring R.	2,000	192.0
Subtotals 7/		23,035	2,453.5
Unidentified:			
Thermal		47,000	N/A
Misc.		2,705	N/A
Subtotals		49,705	-
Totals		75,718	2,853.5 8/

1/ *Hydropower, as detailed in Appendix J; allocated costs as a part of the comprehensive basin plan not determined.*
2/ *For all basin streams; Appendix J, Map II-2, shows locations.*
3/ *Hydro and thermal, as detailed in Appendix J.*
4/ *Potential non-Federal development as of 1968.*
5/ *Conventional hydropower.*
6/ *Pumped-storage peaking.*
7/ *Including interest during construction, at 4-5/8 percent.*
8/ *To the extent identified.*

COMPARISON OF NEEDS AND ACCOMPLISHMENTS

GENERAL

The water, related land, and other resources of Willamette River Basin provide a tremendous potential which can be managed, preserved, and used to satisfy present and projected needs. By such actions, an overall high percentage of projected year 2020 needs can be met.

Some of the factors involved in needs and means for satisfaction are not subject to ready evaluation, or expression in physical or monetary terms. One factor, however, is a major concern and almost a common denominator in discussing satisfaction of needs. That factor is water. The total available supply, and the seasonal distribution of supply, are known. The effects of the plan in the field of water resource control have been evaluated, so far as the multiple-purpose storage system involved is concerned.

The present natural seasonal surface water distribution pattern is one of winter surplus and summer deficiencies in most parts of the basin. The legitimate exercise of State-granted water rights for consumptive uses depletes the already meager-to-nonexistent summer season supply; in many instances, the streams are over-appropriated.

The final hydraulic analysis of storage elements mentioned at the end of Part IV shows how effective the plan would be in controlling the adverse effects of surplus flows. The extent of that accomplishment is summarized in the subsequent discussion of flood control. Other individual functional accomplishments also are compared to needs in similar discussions.

Table V-5 illustrates the overall effect of multiple-purpose storage accomplishment, without reference to or comparison with specific functional requirements, so far as manipulation of seasonal availability is concerned. It shows natural summer flows, the depleted flows if all water rights existing in 1965 were exercised, and the extent to which flows depleted by projected year 2020 usage would be augmented by two conditions of storage development and operation. It is based on average and minimum flows for the month of August during the period 1926-65, inclusive. August flows represent conditions during the period of critical flow deficiency.

Table V-5

Typical flow-augmentation effects

Stream	Station	Average mean monthly flows, cfs				Minimum mean monthly flows, cfs			
		Unregulated		Regulated		Unregulated		Regulated	
		Natural 1/	Depleted 2/	3/	4/	Natural 1/	Depleted 2/	3/	4/
Coast Fork Willamette	Goshen	91	24	600	328	43	0	0	190
Middle Fork Willamette	Jasper	898	791	2,466	1,910	508	401	1,560	1,100
McKenzie	Coburg	2,068	1,313	2,890	2,079	1,279	524	1,638	1,700
Long Tom	Monroe	49	21	28	29	15	0	0	0
Marys	Philomath	19	12	NA	283	9	2	NA	83
Calapooia	Albany	56	47	119	171	25	16	102	102
South Santiam	Waterloo	262	150	1,075	675	126	14	342	600
North Santiam	Mehama	896	110	972	1,042	517	0	0	0
Santiam	Jefferson	1,203	272	1,999	1,934	720	80	402	1,066
Luckiamute	Suver	43	0	NA	299	22	0	NA	248
South Yamhill	Whiteson	50	0	NA	230	20	0	NA	0
North Yamhill	Pike	28	19	NA	18	13	4	NA	0
Pudding	Aurora	71	5	NA	157	32	0	NA	0
Molalla	Canby	93	20	NA	443	42	0	NA	0
Tualatin	West Linn	35	0	79	260	8	0	6	260
Willamette	Eugene	989	867	3,073	2,239	551	453	2,261	1,290
Willamette	Harrisburg	3,006	2,438	5,854	4,214	1,900	1,356	4,710	2,967
Willamette	Albany	3,264	2,575	6,000	4,766	1,990	1,338	4,719	3,135
Willamette	Salem	4,635	2,981	7,309	6,417	2,780	1,475	4,634	3,946
Willamette	Oregon City	5,182	3,006	6,602	7,729	3,080	1,375	3,736	4,334

1/ Natural August flows, based on the period 1926-65, inclusive.
2/ Adjusted for exercise of water rights existing in 1965.
3/ Flows available under projected 2020 conditions, with regulation by base-system storage.
4/ Flows available under projected 2020 conditions, with regulation by base-system and early-action storage.
NA Service not available at base-system level of development.

Data as to regulated or augmented flows which could be expected with the addition of potential long-range storage projects in operation are not shown. Operating curves for those reservoirs will have to be prepared, and overall system operation under alternative operational plans will have to be evaluated, before the effects of those projects on low flows can be determined. As can be seen, however, there would remain as of 2020 considerable need for flow augmentation at many locations in the basin.

Even though significant needs would remain if only early-action storage were added by 2020, the table shows that a considerable improvement would be obtainable through storage development and operation. It also illustrates some of the advantages of better geographical distribution of storage with early-action reservoirs added to the base system. For example, with early-action storage in operation downstream from Salem, system operation to meet downstream needs would not entail as great a draft on upstream storage with accompanying unnecessarily large flows past intermediate points. Under those conditions, the adverse effects of rapid drawdown would be ameliorated to a degree; seasonal flow variations would be reduced; and conditions for fish, wildlife, and general recreation would be improved.

Comparison of flows shown in Table V-5 with needs identified elsewhere in this appendix, in the functional appendixes, or by subsequent studies will indicate the probable degree of accomplishment to be anticipated when early-action storage is available.

FUNCTIONAL COMPARISONS

Storage and/or release of water plays a significant or major role in seven functional fields, so far as early-action period and long-range accomplishments of the basin plan are concerned. Tables IV-4 through IV-14 summarize, for Subbasins 1 through 11, respectively, projected needs and estimated storage accomplishments as of 2020 in each of eight functional fields.

Tables V-6 through V-14, discussed in the following headed paragraphs, summarize by functions the projected needs and the identified accomplishments of all early-action and long-range plan elements in

meeting those needs. In most cases, the tables show accomplishments of the plan in individual subbasins, as well as for the basin as a whole.

Fish and Wildlife

Table V-6 shows projected early-action (1980) and long-range (2020) needs for three species of salmon, two separately timed runs of steelhead, resident trout, and warm-water fish. It also shows projected needs for big game, upland game, and waterfowl. It shows the identified degree of satisfaction which would be provided for those needs.

Fish Life

The table shows that early-action plan elements, except for the proposed pond-rearing program, would not meet 1980 projected needs for anadromous fish. The final effects of the pond-rearing program, which promises a dramatic increase in production, must be evaluated on the basis of additional experience. Similarly, significant unmet anadromous fish needs will remain in 2020, unless pond-rearing is successful. Trout and warm-water fish needs apparently can be met, both in 1980 and 2020, by implementation of access and management programs discussed in Appendix D.

It is significant, however, that the fish life needs shown (1) are projected on the basis of a continuation of present-day average angler-success ratios, and (2) do not include anadromous fish needed for spawning escapement. Those projections are far from the upper limit of the level of fish production which would be used. Any significant increase in angler success could be expected to attract a larger number of anglers, not only from residents of the basin but also from other parts of the State and from the tourist trade. Thus, from a practical standpoint, and in addition to commercial uses, there would remain a use for any additional practicable increment of production which might be realized.

Wildlife

The table shows that presently identified plan accomplishments would fall far short of meeting projected wildlife needs, in terms of hunter-days at a reasonable success ratio. Except for the small increase

Table V-6
Projected total basin needs and identified storage accomplishments - Fish and Wildlife

Item	1980 Fish, Number in 1,000's: Spring Chinook	Fall Chinook	Coho	Summer Steelhead	Winter Steehead	Trout	Warm Water	1980 Wildlife, 1,000 Hunter-Days: Big Game	Upland Game	Water-fowl	2020 Fish, Number in 1,000's: Spring Chinook	Fall Chinook	Coho	Summer Steelhead	Winter Steelhead	Trout	Warm Water	2020 Wildlife 1,000 Hunter-Days: Big Game	Upland Game	Water-fowl
A. *Projected Basin Needs* 1/	265.0	565.0	317.0	186.0	15.0	9,800.0	900.0	1,096.0	1,078.0	339.0	538.0	1,148.0	644.0	369.0	34.0	6,600.0	1,600.0	1,978.0	1,958.0	602.0
B. *Presently Assured Accomplishments*	168.0	379.0	210.0	18.0	10.0	1,900.0	540.0	498.0	612.0	148.0	189.0	718.0	245.0	58.0	14.0	1,300.0	640.0	890.0	1,016.0	210.0
C. *Total Residual Needs*	97.0	186.0	107.0	118.0	5.0	900.0	360.0	667.0	566.0	191.0	349.0	430.0	399.0	543.0	20.0	5,300.0	960.0	1,088.0	942.0	393.0
D. *Early-Action Accomplishments:*	47.6	67.1	21.7	3.6	1.1	4,160.0	-	186.0	338.0	154.6	47.6	67.1	21.7	3.6	1.1	4,160.0	-	186.0	338.0	154.6
Subbasin 1, Coast Fork	20.0	9.4	1.9	-	-	141.0	-	-	-	-	20.0	9.4	1.9	-	-	141.0	-	-	-	-
Subbasin 2, Middle Fork	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 3, McKenzie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 4, Long Tom	-	-	-	-	-	82.0	-	-	-	-	-	-	-	-	-	82.0	-	-	-	-
Subbasin 5, Santiam	11.6	10.5	-	3.3	0.1	493.0	-	-	-	-	11.6	10.5	-	3.3	0.1	493.0	-	-	-	-
Subbasin 6, Coast Range	-	9.3	17.4	0.2	0.7	2,139.0	-	-	-	-	-	9.3	17.4	0.2	0.7	2,139.0	-	-	-	-
Subbasin 7, Pudding	16.0	37.4	1.8	-	0.2	784.0	-	-	-	-	16.0	37.4	1.8	-	0.2	784.0	-	-	-	-
Subbasin 8, Tualatin	-	0.5	0.6	-	0.1	488.0	-	-	-	-	-	0.5	0.6	-	0.1	488.0	-	-	-	-
Subbasin 9, Clackamas	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 10, Columbia	-	-	-	-	-	23.0	-	-	-	-	-	-	-	-	-	23.0	-	-	-	-
Subbasin 11, Sandy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Willamette River	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
E. *Subtotal, Residual Needs*	49.4	116.9	86.8	115.6	0.9	(+2,260.0) 2/	360.0 3/	472.0	552.0	36.6	301.4	367.9	377.3	539.6	8.9	(+660.0)	960.0	1,102.0	606.0	364.6
F. *Long-Range Accomplishments:*	-	-	-	-	-	-	-	-	-	-	11.2	138.2	6.7	1.6	0.6	660.0	-	-	-	-
Subbasin 1, Coast Fork	-	-	-	-	-	-	-	-	-	-	6.0	2.0	2.0	-	0.3	202.0	-	-	-	-
Subbasin 2, Middle Fork	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 3, McKenzie	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 4, Long Tom	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 5, Santiam	-	-	-	-	-	-	-	-	-	-	5.2	9.6	1.2	1.1	0.1	-	-	-	-	-
Subbasin 6, Coast Range	-	-	-	-	-	-	-	-	-	-	-	0.4	0.9	0.4	0.1	72.0	-	-	-	-
Subbasin 7, Pudding	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 8, Tualatin	-	-	-	-	-	-	-	-	-	-	-	0.2	0.8	-	-	-	-	-	-	-
Subbasin 9, Clackamas	-	-	-	-	-	-	-	-	-	-	-	11.0	1.8	-	0.1	383.0	-	-	-	-
Subbasin 10, Columbia	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subbasin 11, Sandy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Willamette River	-	-	-	-	-	-	-	-	-	-	-	120.0	-	-	-	-	-	-	-	-
G. *Year 2020 Conditions:*																				
Total needs	-	-	-	-	-	-	-	-	-	-	580.2	884.7	379.6	538.0	9.3	-	960.0 2/	1,102.0	606.0	364.6
Additional capacity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,807.0 2/	-	-	-	-

1/ *Minimum needs. Anadromous fish for harvest only; does not include spawning escapement. Use would increase commensurate with any additional supply.*
2/ *At present smolt-success ratio, which generally represents only one-fourth of the administratively established legal daily catch limit; additional fish would be used, to the extent available.*
3/ *Could be met by implementation of access and management programs discussed in Ann. I, Fish and Wildlife.*

in waterfowl hunter-days from 1980 to 2020, all of the plan accomplishments stem from early-action programs described in Appendix D and which would rapidly become fully effective. The only identified beneficial effect of water development projects would be the provision of opportunity for additional waterfowl hunter-days.

Flood Control

Table V-7 summarizes projected early-action (1980) and long-range (2020) flood control needs in terms of acre-feet of effective storage, areal control of runoff, and average annual flood damages. It shows for each subbasin, for Willamette River, and for the basin as a whole, the identified degree of satisfaction which would be provided for those needs. Average annual damages are shown on the basis of no change in the present degree of local regulation of flood plain use. A major part of the damage prevention shown represents only one function of multiple-purpose projects needed in other functional fields but dependent on use for flood control as a significant factor in economic justification. On that basis, additional or modified regulation, to be adjusted in scope and degree as additional protection becomes available, is proposed as an essential complement to project and other program effects, rather than as an alternative.

The table shows that proposed early-action projects would satisfy about 16 percent of the residual storage needs above Willamette Falls and eliminate about 41 percent of the damages projected for 1980. The additional projects in the long-range segment of the plan would provide about 12 percent of the storage still needed after early-action projects would be in operation. Total damage prevention benefits for long-range projects have not been evaluated, but would approximate one-third of the residual.

The table also shows that control of floods would provide for increased use of lands now in the flood plain. The proposed local flood-plain-use-regulation program should be kept current with structural measures, so as to permit appropriate uses as the degree of protection increases.

Table V-7
Projected total basin needs and identified 1/ plan accomplishments - Flood Control

Item	Needs and Accomplishments 1980 2/ Storage, 1,000 ac.-ft. 4/	Runoff Control from Area, sq. mi. 4/	Average Annual Values, $1,000 Flood Damages	Increased Land Use	2020 3/ Storage, 1,000 ac.-ft. 4/	Runoff Control from Area, sq. mi. 4/	Average Annual Values, $1,000 Flood Damages	Increased Land Use
A. *Projected Total Basin Needs*	*3,700*	*7,458*	*46,500 5/*	*6/*	*3,700*	*7,458*	*213,500*	*6/*
B. *Presently Assured Accomplishments*	*1,850*	*3,277*	*39,400 7/*	*N/A*	*1,850*	*3,277*	*193,200 7/*	*N/A*
C. *Total Residual Needs*	*1,850*	*4,181*	*7,100*	*N/A*	*1,850*	*4,181*	*20,300*	*N/A*
D. *Early-Action Accomplishments*	*352*	*1,023*	*2,882*	*1,955*	*352*	*1,023*	*5,523*	*3,993*
Subbasin 1 - Coast Fork	9	16	29	4	9	16	38	6
Subbasin 2 - Middle Fork	-	-	33	1	-	-	48	1
Subbasin 3 - McKenzie	-	-	15	-	-	-	23	-
Subbasin 4 - Long Tom	2	9	29	5	2	9	29	5
Subbasin 5 - Santiam	95	167	522	185	95	167	896	394
Subbasin 6 - Coast Range	157	497	481	316	157	497	960	634
Subbasin 7 - Pudding	89	334	506	144	89	334	946	263
Subbasin 8 - Tualatin	-	-	233	156	-	-	438	313
Subbasin 9 - Clackamas	-	-	29	-	-	-	43	-
Subbasin 10 - Columbia	-	-	50	5	-	-	50	5
Subbasin 11 - Sandy	-	-	12	-	-	-	18	-
Willamette River	-	-	988	1,139	-	-	2,034	2,372
E. *Subtotal, Residual Needs*	*1,498*	*3,158*	*4,218*	-	*1,498*	*3,158*	*14,777*	-
F. *Long-Range Accomplishments*	-	-	-	-	*176*	*414*	-	-
Subbasin 1 - Coast Fork	-	-	-	-	70	77	N/A	N/A
Subbasin 2 - Middle Fork	-	-	-	-	4	26	N/A	N/A
Subbasin 3 - McKenzie	-	-	-	-	3	33	N/A	N/A
Subbasin 4 - Long Tom	-	-	-	-	17	-	N/A	N/A
Subbasin 5 - Santiam	-	-	-	-	58	166	N/A	N/A
Subbasin 6 - Coast Range	-	-	-	-	20	89	N/A	N/A
Subbasin 7 - Pudding	-	-	-	-	1	-	N/A	N/A
Subbasin 8 - Tualatin	-	-	-	-	3	23	N/A	N/A
Subbasin 9 - Clackamas	-	-	-	-	(105) 8/	-	N/A	N/A
Subbasin 10 - Columbia	-	-	-	-	-	-	N/A	N/A
Subbasin 11 - Sandy	-	-	-	-	-	-	N/A	N/A
Willamette River	-	-	-	-	-	-	N/A	N/A
G. *Year 2020 Conditions:*								
Unmet Needs	-	-	-	-	*1,322*	*2,744*	*N/A*	*N/A*
Additional Capacity	-	-	-	-	*0*	*0*	*0*	*0*

N/A Not available.

1/ All plan elements except the flood plain use regulation program.
2/ Based on needs projected for 1980 and assumed availability of early-action services at that time, except as noted in footnote 1/.
3/ Based on needs projected for 2020 and total identified plan services, except as noted in footnote 1/.
4/ Illustrated by effective amount for control of a 100-year flood at Willamette Falls; optimum goal would be prevention of all flood damages.
5/ Damages with no change in present degree of flood plain use regulation.
6/ Needs not quantified; flood plain has multiple present and prospective uses, some of which do not require control of floods.
7/ Average annual damages prevented.
8/ Downstream from Willamette Falls; not effective in meeting needs at that point.

Irrigation

Table V-8 summarizes the acreage expected to be irrigated and demonstrates that early-action and long-range plans can meet the irrigated acreage projections for 1980 and 2020 as shown in Appendix F - Irrigation. It should be noted that only about one-third of the land in the early-action projects is expected to be in production by 1980.

It also summarizes the water supply needed to serve lands expected to be irrigated in 1980 and 2020. A considerable portion of that water can be obtained from natural flow; farm ponds; ground water; and storage in existing, authorized, and assured reservoirs. However, some strategically located new storage reservoirs will be required to serve those lands which cannot obtain water economically from the sources mentioned.

Not all of the water reserved for irrigation in existing and authorized Federal reservoirs constructed by the Corps of Engineers will be needed for that purpose. Consideration will be given, in subsequent studies, to reauthorization of those reservoirs and possible reassignment to other functions of that portion of storage not needed for irrigation use. Additional studies will be required to delineate locations and quantities involved.

Land Measures and Watershed Protection

Table V-9 summarizes projected total basin needs, accomplishments as of 1965, residual needs, and the degree to which those needs would be met by early-action and long-range plan elements. Included in plan elements are the various programs described in detail in Appendix G, and the small watershed projects described in the following section. It shows the projected changes in land use, from 1965 to 1980 and from 1980 to 2020; and the resulting acreage of land with treatment needs, as defined in Appendix G. It also shows for farmland, for forest and woodland, and for small watersheds, the needed and planned program and project measures for those time intervals. The table indicates plan capability to meet all identified early-action needs and a portion of the long-range needs. Those long-range needs which would not be satisfied would have to be considered in the future as elements of further studies to keep the plan up to date.

Table V-8
Total projected basin needs and identified plan accomplishments - Irrigation

Item	1980 Development, 1,000 ac.	1980 Water Supply, 1,000 ac.-ft.	2020 Development, 1,000 ac.	2020 Water Supply, 1,000 ac.-ft.
A. *Total Projected Irrigation Demand* 1/	*430*	-	*1,000*	-
B. *Total Projected Water Supply Need* 2/	-	*1,158*	-	*2,460*
C. *Presently Assured Accomplishments:*	*311*	*958*	*474*	*1,795*
Existing Development	244	-	244	-
Authorized and Assured Projects 3/	23	-	23	-
Net Increase in Private Development 4/	44	-	207	-
Surface Water 5/	-	673	-	1,282
Groundwater	-	285	-	513
D. *Residual Needs*	*119*	*200*	*526*	*665*
E. *Plan Accomplishments:*	*119*	*200*	*526*	*665*
Early-Action Projects	119 6/	200	319	643
Long-Range Projects	-	-	207	22 7/
F. *Unmet Needs*	*0*	*0*	*0*	*0*

1/ *Based on the basin meeting its proportionate share in satisfying National needs for food and fiber.*
2/ *For the total acreage shown.*
3/ *Tualatin project, 12,000 acres; McKay-Rock Creek, 7,800 acres; Amazon-Flat Creek, 3,000 acres.*
4/ *Adjusted to reflect conversion of irrigable and irrigated lands to urban use.*
5/ *Natural flows and stored water.*
6/ *Only about one-third of the total early-action acreage would be developed by 1980.*
7/ *Water supply for a majority of the long-range irrigation projects will be provided by existing, authorized, and early-action storage projects.*

Municipal and Industrial Water

Table V-10 summarizes projected early-action (1980) and long-range (2020) water supply needs and plan accomplishments, by subareas and for the basin as a whole. The accomplishments shown include the effects of development and use of ground water sources, natural surface flows, and storage projects.

The table shows a capability to meet early-action needs, and to meet all but a portion of long-range needs. The unmet long-range needs could be satisfied by locally-planned interbasin diversion of a small amount of stored water. Thus, in effect, the plan provides for satisfaction of all recognized needs.

Navigation

Table V-11 summarizes projected early-action (1980) and long-range (2020) needs for water transportation of commodities which could not be moved economically in the navigation channel now authorized. It also shows the degree to which a potential enlarged channel project would satisfy those needs. In both the early-action and long-range periods, the only unmet need is shown to be for transportation of some additional wood chips. In actual practice, that unmet need might increase or decrease depending on actual operating experience and the resulting degree to which water transport is competitive with land movement. Further study of all aspects of navigation will be required for firm definition of the degree to which needs can be met.

Power

Table V-12 summarizes projected early-action (1980) and long-range needs for electric power generation, and estimated accomplishments of the basin plan. It shows that early-action and long-range net imports in the order of 6,670 megawatts and 16,000 megawatts, respectively, would be available. The plan would then satisfy early-action needs. Long-range plan elements include almost 75,000 megawatts of generating capacity. That capacity might be provided by additional development of some combination of nuclear- or exotic-fueled thermal, pumped-storage, and conventional hydro opportunities. Considerable additional

Item	Land Use, 1,000 Acres: Dry Cropland	Irrigated Cropland	Forest Land	Pasture	Urban and Other	Land Treatment 1/: 1,000 ac.	$1 million
A. *Projected Total Basin, 2020*	*372*	*1,000*	*4,885*	*113*	*1,339*	*4,585*	*308*
B. *Accomplishment, (1965)*	*1,212*	*244*	*5,101*	*237*	*915*	*1,974*	*118*
C. *Residual Basin Needs, (1965)*	*-840*	*+756*	*-216*	*-124*	*424*	*2,611*	*190*
D. *Accomplishments, New Plan Elements:*							
Early-Action (1980)	-207	+186	- 47	- 35	+103	1,045	76
Subbasin 1 - Coast Fork	- 8	+ 5	+ 1	- 2	+ 4	29	2.1
Subbasin 2 - Middle Fork	- 1	+ 1	- 4	- 1	+ 4	9	.7
Subbasin 3 - McKenzie	- 1	+ 1	-	- 1	+ 1	20	1.5
Subbasin 4 - Long Tom	- 20	+ 9	- 1	- 5	+ 16	162	11.8
Subbasin 5 - Santiam	- 28	+ 28	- 1	- 5	+ 6	325	23.6
Subbasin 6 - Coast Range	- 78	+ 89	- 10	- 14	+ 13	282	20.5
Subbasin 7 - Pudding	- 30	+ 31	- 8	- 4	+ 11	95	6.9
Subbasin 8 - Tualatin	- 32	+ 24	- 2	- 2	+ 13	24	1.7
Subbasin 9 - Clackamas	- 1	+ 1	- 3	-	+ 3	90	6.6
Subbasin 10 - Columbia	- 7	- 3	- 18	- 1	+ 30	7	.5
Subbasin 11 - Sandy	- 1	-	- 1	-	+ 2	2	.1
E. *Residual Basin Needs, (1980)*	*-633*	*570*	*-169*	*- 89*	*+321*	*1,566*	*114*
Long-Range (2020) 11/	-633	+570	-169	- 89	+321	940	(68)
Subbasin 1 - Coast Fork	- 8	+ 12	- 8	- 7	+ 11	26	-
Subbasin 2 - Middle Fork	- 3	+ 4	- 3	- 1	+ 3	8	-
Subbasin 3 - McKenzie	- 4	+ 1	- 2	-	+ 5	18	-
Subbasin 4 - Long Tom	- 53	+ 33	- 10	- 14	+ 44	146	-
Subbasin 5 - Santiam	-147	+150	- 3	- 11	+ 11	292	-
Subbasin 6 - Coast Range	-172	+176	- 15	- 19	+ 30	254	-
Subbasin 7 - Pudding	-155	+154	- 12	- 12	+ 25	85	-
Subbasin 8 - Tualatin	- 38	+ 25	- 37	- 8	+ 58	22	-
Subbasin 9 - Clackamas	- 18	+ 18	- 9	- 4	+ 13	81	-
Subbasin 10 - Columbia	- 30	- 8	- 67	- 10	+115	6	-
Subbasin 11 - Sandy	- 5	+ 5	- 3	- 3	+ 6	2	-
F. *Residual Basin Needs, (2020)*	*0*	*0*	*0*	*0*	*0*	*626 7/*	*46 7/*

1/ Status of land treatment on private lands; based on 40 percent accomplishment through early-action period and 60 accomplishment by year 2020.
2/ Group enterprises involving 2 to 6 landowners.
3/ Erosion control, stabilization, and restoration measures.
4/ Investment in permanent facilities and improvements.
5/ Acres requiring additional planning and application of conservation and land treatment practices concurrent with of project structural measures.
6/ Projections made only for early-action period; long-range projections considered to be more appropriate as part o comprehensive plan up to date.
7/ Unmet land treatment needs in small watersheds described in footnote 8/.

Table V-9

Projected basin needs and estimated accomplishments - Land Measures and Watershed Protection

Program and Proj

Farmland 2/		Forest and Woodland 3/						Projects		Land Tre
		U. S. Forest Service		Bureau of Land Management		Private			Size	Measure
No.	$1 million	No.	$1 million	No.	$1 million	No.	$1 million	No.	1,000 ac.	1,000 ac.
6/	6/	6/	6/	6/	6/	6/	6/	76	2,775	562
675	31.5	-	149 4/	-	20 4/	-	-	6	221	67
-	-	-	-	-	-	-	-	70	2,554	495
133	7.0	210	2.1	130	.4	24	.4	26	961	251
6	.1	-	.1	33	.1	-	-	2	50	12
5	.2	44	.5	13	.1	-	-	1	8	1
2	*	38	.2	16	*	-	-	-	-	-
8	.2	-	-	6	.1	-	-	3	98	19
11	.6	29	.1	28	*	3	.1	4	170	35
52	2.7	7	*	7	*	6	*	9	327	100
22	1.7	-	-	9	*	7	.1	3	162	48
22	1.5	-	-	-	-	-	*	2	102	22
1	*	71	1.0	13	*	6	*	-	-	-
4	*	-	-	2	*	-	-	2	44	14
0	-	21	.1	3	*	2	.1	-	-	-
-	-	-	-	-	-	-	-	44	1,534	244
-	-	-	-	-	-	-	-	44	1,534	(244)
-	-	-	-	-	-	-	-	6	154	-
-	-	-	-	-	-	-	-	2	76	-
-	-	-	-	-	-	-	-	2	134	-
-	-	-	-	-	-	-	-	2	98	-
-	-	-	-	-	-	-	-	6	229	-
-	-	-	-	-	-	-	-	10	385	-
-	-	-	-	-	-	-	-	7	214	-
-	-	-	-	-	-	-	-	4	95	-
-	-	-	-	-	-	-	-	3	74	-
-	-	-	-	-	-	-	-	2	75	-
-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	50 8/	0	0

ercent

installation

keeping

8/ Number of small watersheds remaining in the basin which have land treatment require elements involving structural measures.

9/ Included in Table V-7 for Flood Control.

10/ Price base 1966; 4-5/8-percent interest rate for early-action plan elements.

11/ Estimates of basin totals in ( ) not allocated to subbasins for long-range plan ele

12/ AWM: agricultural water management, including irrigation and drainage.

* Less than $50,000.

ect Measures

Small Watersheds									
	Structural Measures								
atment s 5/	Reservoirs		Channel Improvement,	Cost, $1 million		Annual Benefits, $1 thousand			
$1 million	No.	1,000 ac.-ft.	Miles	Capital	Annual 10/	Flood 9/	AWM 12/	Other	Total
30.2	*71*	*756*	*589*	*134*	*6.4*	*1,649*	*5,066*	*4,184*	*10,899*
2.7	*2*	*33*	*124*	*20*	*.4*	*565*	*481*	*1,668*	*2,714*
27.5	*69*	*723*	*465*	*114*	*6.0*	*1,084*	*4,585*	*2,456*	*8,125*
10.0	39	325	187	49	2.6	584	1,885	1,156	3,625
.4	3	31	4	3.1	.2	21	98	89	208
.1	-	-	4	.3	*	6	20	-	26
-	-	-	-	-	-	-	-	-	-
.7	6	43	12	5.5	.3	35	139	169	343
2.3	-	-	58	2.0	.1	224	414	-	638
3.8	16	148	73	20.6	1.1	155	724	375	1,254
1.8	7	65	21	9.1	.5	72	326	344	742
.8	4	32	12	6.2	.3	36	127	134	297
-	-	-	-	-	-	-	-	-	-
.1	3	6	3	2.2	.1	55	-	60	115
-	-	-	-	-	-	-	-	-	-
17.5	*30*	*398*	*278*	*65*	*3.4*	*500*	*2,700*	*1,200*	*4,500*
(17.5)	30	398	278	(65)	(3.4)	(500)	(2,700)	(1,200)	(4,500)
-	1	8	20	-	-	-	-	-	-
-	2	23	2	-	-	-	-	-	-
-	2	37	16	-	-	-	-	-	-
-	2	34	28	-	-	-	-	-	-
-	6	53	86	-	-	-	-	-	-
-	10	134	53	-	-	-	-	-	-
-	1	25	28	-	-	-	-	-	-
-	2	27	38	-	-	-	-	-	-
-	1	21	2	-	-	-	-	-	-
-	3	36	5	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-
0	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

nents but are not proposed as new plan

ements.

Table V-10

Projected total basin needs and identified plan accomplishments - M&I Water Supply

Item	Needs and Accomplishments 1,000 ac.-ft. 1980 1/	2020 2/
A. *Projected Total Basin Needs:*	*688.6*	*1,613.7*
1. Upper Subarea	128.2	273.4
2. Middle Subarea	186.3	374.0
3. Lower Subarea	374.1	966.3
B. *Presently Assured Accomplishments 3/:*	*653.8*	*1,192.7*
1. Upper Subarea	128.2	272.4
2. Middle Subarea	185.5	361.0
3. Lower Subarea	340.1	559.3
C. *Total Residual Needs:*	*34.8*	*421.0*
1. Upper Subarea	0	1.0
2. Middle Subarea	0.8	13.0
3. Lower Subarea	34.0	407.0
D. *Early-Action Accomplishments 4/:*	*34.8*	*67.0*
1. Upper Subarea	0	0
2. Middle Subarea	0.8	13.0
3. Lower Subarea	34.0	54.0
E. *Subtotal, Residual Needs:*	*0*	*354.0*
1. Upper Subarea	0	1.0
2. Middle Subarea	0	0
3. Lower Subarea	0	353.0
F. *Long-Range Accomplishments:*	-	*316.0*
1. Upper Subarea	-	1.0
2. Middle Subarea	-	0
3. Lower Subarea	-	315.0
G. *Year 2020 Conditions:*	-	*38.0 5/*
1. Upper Subarea	-	0
2. Middle Subarea	-	0
3. Lower Subarea	-	38.0 5/

1/ *Based on needs projected to 1980 and assumed availability of early-action services at that time.*

2/ *Based on needs projected to 2020 and total identified plan services.*

3/ *Includes capability of natural flows; groundwater; existing, authorized, and assured reservoirs; and anticipated municipal storage development.*

4/ *Includes Federal projects, by Corps of Engineers and Bureau of Reclamation; Federally assisted projects, by Soil Conservation Service and local interests; and the Bull Run development of the City of Portland.*

5/ *To be supplied by planned non-Federal importation, from the adjacent coastal watershed, into Tualatin Subbasin.*

Table V-11
Projected total basin needs and identified 1/ plan accomplishments - Navigation

Item	Tonnages, 1,000's, as of 1980 2/					Tonnages, 1,000's, as of 2020 3/				
	Wood Chips	L.P. Gas	Greases	Asphalt	Agric. Chem.	Wood Chips	L.P. Gas	Greases	Asphalt	Agric. Chem.
A. *Projected Total Basin Needs 4/*	3,612	28	28	163	415	2,697	35	50	369	595
B. *Presently Assured Accomplishments 5/*	-	-	-	-	-	-	-	-	-	-
C. *Total Residual Needs*	3,612	28	28	163	415	2,697	35	50	369	595
D. *Early-Action Accomplishments 6/*	1,238	28	28	163	-	-	-	-	-	-
E. *Subtotal, Residual Needs*	2,374	0	0	0	0	-	-	-	-	-
F. *Long-Range Accomplishments 6/*	-	-	-	-	-	924	35	50	369	595
G. *Year 2020 Conditions:*										
Unmet Needs	-	-	-	-	-	1,773	0	0	0	0
Additional Capacity 7/	-	-	-	-	-	-	-	-	-	-

1/ *Tentative; assumes that, for as-yet-undetermined channel dimensions, stored water available in existing, authorized, and new major reservoirs will be adequate to provide needed increase to natural flow in Willamette River.*
2/ *Based on needs projected to 1980 and assumed availability of early-action services at that time.*
3/ *Based on needs projected to 2020 and total identified plan services.*
4/ *Excluding rafted logs and other commodities which are accommodated by existing project depths; see Appendix I for details.*
5/ *The existing project will not accommodate the larger equipment required for economical transportation of the commodities and tonnages shown.*
6/ *Project dimensions finally selected for early-action period would be continued through the long-range period. Tonnages shown are for intrabasin movement; see Appendix I for details.*
7/ *If increased demands warrant such action, additional units of appropriately-sized floating equipment could transport additional tonnages over the waterway.*

Table V-12
Projected total basin needs and identified plan accomplishments - Power

	Needs and Accomplishments			
	1980 [1]		2020 [2]	
	Firm Energy Million kwh	Peaking Capacity Kilowatts	Firm Energy Million kwh	Peaking Capacity Kilowatts
A. *Projected Total Basin Needs*	*38,400*	*7,730,000* [3]	*457,000*	*91,800,000* [3]
B. *Presently Assured Accomplishments* [4]	*5,600*	*1,060,000*	*5,600*	*1,060,000*
C. *Projected Net Imports*	*32,800*	*6,670,000*	*78,600*	*16,000,000*
D. *Total Residual Needs*	*0*	*0*	*372,800*	*74,740,000*
E. *New Accomplishments:*	-	-	*372,800*	*74,740,000*
1. Early-action projects:				
None	-	-	-	-
2. Long-range projects:				
Subbasin 4, Long Tom:				
Nuclear-fueled thermal	-	-	7,400	1,000,000
Subbasin 5, Santiam:				
Nuclear-fueled thermal	-	-	7,400	1,000,000
Little Meadow, pumped-storage	-	-	[5]	1,000,000
Snow Peak, pumped-storage	-	-	[5]	4,000,000
Subtotals	-	-	7,400	6,000,000
Subbasin 9, Clackamas:				
Shellrock, conventional hydro	-	-	100	35,000
Battle Creek, pumped-storage	-	-	[5]	6,000,000
Cache Meadow, pumped-storage	-	-	[5]	4,000,000
Cottonwood, pumped-storage	-	-	[5]	6,000,000
Squaw Meadow, pumped-storage	-	-	[5]	2,000,000
Subtotals			100	18,035,000
Unidentified			357,900	49,705,000 [6]
F. *Year 2020 Conditions:*				
1. *Unmet needs*	-	-	*0*	*0*
2. *Additional capacity*	-	-	-	-

1/ Based on needs projected to 1980 and assumed availability of early-action services at that time.
2/ Based on needs projected to 2020 and total identified plan services.
3/ Peak load for year.
4/ Includes hydro and thermal installations existing in basin in 1969; assumes rehabilitation and/or replacement as necessary to maintain present total capacity.
5/ Energy used in pumping in excess of generation at-site would be non-firm generation in off-peak hours.
6/ Of this total, about 47 million kw probably would be supplied by nuclear-fueled or other exotic-fueled base-load plants; the remaining 2,705,000 could be obtained by developing other opportunities.

study, however, would be required to arrive at the best long-range means of meeting power, environmental, and related needs.

Recreation

Table V-13 summarizes projected early-action (1980) and long-range (2020) needs for and accomplishments with respect to facilities and resource capacity for water-related recreation. Data are shown for the upper, middle, and lower subareas.

As of 1980, residual needs for facilities and a surplus of resource capacity exist in each subarea. If the early-action portion of all recreation programs could be implemented by 1980, and if all early-action project facilities were available at that time, an over supply of both facilities and resource capacity would be available; in other words, total recreation opportunities then available would not be fully utilized.

As of 2020, assuming complete implementation of all plan elements for recreation, there would be substantial over supplies, or considerably less than ultimate utilization, of facilities and resource capacity in the upper and middle subareas. In the lower subarea, there would remain unmet needs.

The facility deficit shown for the lower subarea could be reduced by additional development of either or both project and program potentials; the year 2020 shortage of resource capacity could be accommodated only by use of water areas in other subareas or outside the basin.

Water Pollution Control

Table V-14 summarizes, for three critical stream reaches, the projected early-action (1980) and long-range (2020) needs for flows to supplement at-source waste treatment. It also shows the degree to which those needs could be met by early-action multiple-purpose storage projects.

Based on one in 10 low mean monthly flows, the summer requirements for 1980 would be more than satisfied. By 2020, demands are projected to increase to the extent that there would be some unmet need in two of the three stream reaches.

Table V-13
Projected total basin needs and identified plan accomplishments - Water-related Recreation

Item	1980 Recreation-Days, 1,000's								2020 Recreation-Days, 1,000's							
	Facilities by Subarea				Resource Capacity by Subarea				Facilities by Subarea				Resource Capacity by Subarea			
	Upper	Middle	Lower	Total	Upper	Middle	Lower	Total	Upper	Middle	Lower	Total	Upper	Middle	Lower	Total
A. Total Water-Related Demands 1/	*3,662*	*8,906*	*10,978*	*23,546*	*3,662*	*8,906*	*10,978*	*23,546*	*10,007*	*21,286*	*29,349*	*60,642*	*10,007*	*21,286*	*29,349*	*60,642*
B. Available as of 1980 2/	*2,768*	*3,868*	*7,632*	*14,268*	*21,222*	*21,286*	*13,113*	*55,630*	*2,768*	*3,868*	*7,632*	*14,268*	*21,222*	*21,286*	*13,113*	*55,630*
C. Residual Demands	*894*	*5,048*	*3,346*	*9,288*	-	-	-	-	*7,239*	*17,373*	*21,717*	*46,329*	-	-	*16,236*	*4,962*
D. Surplus	-	-	-	-	*17,560*	*12,389*	*2,138*	*32,084*	-	-	-	-	*11,215*	*59*	-	-
E. Accomplishments of the Plan:	*2,800*	*6,600*	*4,448*	*13,617*	*3,296*	*11,949*	*2,665*	*17,910*	*12,211*	*28,388*	*21,173*	*56,769*	*4,101*	*13,134*	*4,295*	*21,530*
Storage Projects:																
Existing, authorized & assured	1,350	545	1,300	3,195	1,365	1,765	1,650	4,780	4,410	1,695	1,650	7,755	1,365	1,765	1,650	4,780
Early-action 3/	495	2,292	345	3,132	1,931	10,184	1,015	13,130	1,738	8,745	1,015	11,498	1,931	10,184	1,015	13,130
Long-range	-	-	-	-	-	-	-	-	225	305	335	865	805	1,185	1,630	3,620
Subtotals	1,845	2,837	1,645	6,327	3,296	11,949	2,665	17,910	6,373	10,745	3,000	20,118	4,101	13,134	4,295	21,530
Programs: 4/																
Local	-	-	70	70	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
County	266	476	594	1,336	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
State	93	1,129	751	1,973	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
Private-sector	50	449	250	749	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
Forest Service	196	985	840	2,021	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
Bureau of Land Management	116	580	280	976	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
Fish and Wildlife Service	-	50	15	65	-	-	-	-	N/A	N/A	N/A	N/A	-	-	-	-
Subtotals	721	3,669	2,800	7,190	-	-	-	-	5,838	12,640	18,173	36,651	-	-	-	-
F. Unmet Needs	-	-	-	-	-	-	-	-	-	-	*644*	-	-	-	*11,841*	-
G. Over Supply	*1,671*	*1,468*	*1,099*	*4,234*	*20,856*	*24,338*	*4,800*	*49,994*	*4,672*	*6,012*	-	*10,440*	*15,316*	*13,193*	-	*16,668*

N/A Not available; assignment of long-range responsibilities to agencies and entities cannot be made at present.
1/ From Table III-1, Appendix K.
2/ From Tables III-3 and -4, Appendix K.
3/ Assumed to be available as of 1980; it is recognized that few, if any, are apt to be completed at that time.
4/ From Tables IV-3, -4, and -5, Appendix K.

Table V-14

Projected total basin needs and identified plan accomplishments - Water Pollution Control 1/

Item	Needs and Accomplishments, Cfs													
	1980 2/							2020 3/						
	Nov.-Apr.	May	June	July	August	Sept.	Oct.	Nov.-Apr.	May	June	July	August	Sept.	Oct.
A. *Projected Needs 4/, Critical Streams:*														
1. Willamette River, Portland harbor	1,600-2,400	3,200	4,200	6,200	6,200	5,100	3,000	2,700-3,100	4,100	5,100	7,500	7,500	6,200	3,700
2. Tualatin River, nr. Willamette	40-130	30	40	140	140	120	30	110-250	90	140	270	260	200	100
3. Pudding River, nr. Aurora	20	20	40	120	130	100	20	20	20	30	150	160	130	20
B. *Presently Assured Accomplishments:* 5/ 6/														
1. Willamette River, Portland harbor	7,387	15,879	10,136	6,303	4,636	4,229	5,280	7,387	15,879	10,136	6,303	4,636	4,229	5,280
2. Tualatin River, nr. Willamette	219	430	217	106	58	56	90	219	430	217	106	58	56	90
3. Pudding River, nr. Aurora	202	327	203	79	39	59	71	202	327	203	79	39	59	71
C. *Total Residual Needs:*														
1. Willamette River, Portland harbor	(+5,787/+4,987) 7/	(+12,679)	(+5,936)	(+103)	1,564	871	(+2,280)	(+4,687/+4,287)	(+11,779)	(+5,036)	1,197	2,864	1,971	(+1,580)
2. Tualatin River, nr. Willamette	(+179/+89)	(+400)	(+177)	34	82	64	(+60)	(+109)/31	(+320)	(+77)	164	202	144	10
3. Pudding River, nr. Aurora	(+62)	(+188)	(+80)	72	98	77	(+7)	(+62)	(+188)	(+90)	102	123	107	(+7)
D. *Early-Action Accomplishments:* 8/														
1. Willamette River, Portland harbor	9,703	-1,352	-417	1,829	3,625	4,607	8,990	12,571	-3,097	-1,290	1,853	2,205	2,620	5,214
2. Tualatin River, nr. Willamette	-99	-81	-77	164	202	144	60	-45	-91	-77	164	202	144	134
3. Pudding River, nr. Aurora	178	47	-103	71	125	76	145	-14	-136	-143	71	102	66	64
E. *Subtotal, Residual Needs:*														
1. Willamette River, Portland harbor	(+15,490/+14,690)	(+11,327)	(+5,519)	(+1,932)	(+2,061)	(+3,736)	(+11,270)	(+17,258/+16,858)	(+8,682)	(+3,746)	(+656)	659	(+649)	(+6,794)
2. Tualatin River, nr. Willamette	(+80)/10	(+319)	(+100)	(+130)	(+120)	(+80)	(+120)	(+64)/76	(+249)	0	0	0	0	(+124)
3. Pudding River, nr. Aurora	(+360)	(+354)	(+60)	(+30)	(+34)	(+35)	(+196)	(+168)	(+171)	(+30)	0	19	5	(+115)
F. *Long-Range Accomplishments:*														
1. Willamette River, Portland harbor	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2. Tualatin River, nr. Willamette	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3. Pudding River, nr. Aurora	-	-	-	-	-	-	-	N/A	N/A	N/A	N/A	N/A	N/A	N/A
G. *Year 2020 Conditions:* 5/ 9/														
1. Willamette River, Portland harbor	-	-	-	-	-	-	-	19,958	12,782	8,846	8,156	6,841	6,849	10,494
2. Tualatin River, nr. Willamette	-	-	-	-	-	-	-	174	339	140	270	260	200	224
3. Pudding River, nr. Aurora	-	-	-	-	-	-	-	188	191	60	150	141	125	135

N/A Not available.

1/ For critical stream reaches. Requirements for all other major streams will be met by maintaining minimum flows required for fish life.

2/ Based on needs projected to 1980 and assured availability of early-action services at that time.

3/ Based on needs projected to 2020 and identified flow augmentation.

4/ Calculated on the basis of meeting dissolved oxygen standards after at-source treatment; for practical purposes, maximum month flows should be considered minimum desirable flows on a year-around basis.

5/ One in 10 low mean monthly flows.

6/ Natural flows, not adjusted for water rights.

7/ (+) denotes supply in excess of need.

8/ Incremental effect of storage operation.

9/ Reflects only early action development.

OVERALL EFFECTS AND IMPACTS

General

This section supplements preceding text on comparison of needs and accomplishments, by summarizing in general terms the probable overall effects and impacts of the plan. The subsequent section on Early-Action Elements presents more detail as to immediate effects and impacts.

The comprehensive basin plan would provide service to existing and projected needs in all functional fields now recognized as appropriate for Federal water resource projects. It makes allowance for private-sector and public non-Federal, as well as Federal, development. It includes provisions for formal recognition of functions now served incidental to operation of existing and assured projects for presently authorized project purposes. It includes appropriate physical modifications and opportunity for operational modifications to permit existing and authorized projects, operating together with proposed additional projects, to provide maximum practicable overall needs satisfaction. It provides for increased use of the potential represented by existing and authorized projects, and for maximum practicable use of the potential available at sites to be developed. Even at that level of overall development, it includes provisions for a substantial level of environmental preservation.

Functional

In terms of present and projected functional needs for water and related resource development, implementation of the plan would provide a high degree of service during the early-action period. It would continue to provide for a high level of needs satisfaction during the remainder of the period to 2020, and beyond. It is adaptable to continuation and expansion, as future needs warrant, and it leaves untouched a large reserve of identified alternatives and opportunities for future development.

An exact definition of the degree of service, or needs satisfaction, in each functional field is complicated by the need to consider both quantity and quality; that is, by the need to consider both the degree of physical service to individual functions and the overall quality of

life in the environment as it would exist with the plan in effect. Even individual functions include quality considerations. For example, a projected need for 1,000 fisherman days at present success levels would involve the catching of about 2,500 trout. Provision of 3,000 trout in a commercial catch-and-pay fishing pond, with a three-trout-per-day catch limit, would more than satisfy the physical measure of needs, possibly at reduced cost to the fisherman; it would fail completely, however, to satisfy the desires of a majority of present trout fishermen. Thus, any assessment of overall project effects is a matter of judgment and evaluation in the light of the experiences and desires of the assessor.

The Task Force believes that, overall, the comprehensive basin plan would be highly beneficial, both in individual functional fields and in terms of quality of life and well-being of people.

Because it is a composite, formulated to provide maximum justifiable overall service to a wide range of needs, the plan would not provide service to all needs in any field. Table V-15 summarizes, from preceding individual functional summaries, the estimated degree of service which would be provided in each functional field, as of 2020, by the overall plan.

Each of the new projects in the plan would be individually formulated, in subsequent agency studies, to include a maximum practical level of mitigation of incidental damages. Mitigation measures would be provided for loss of spawning and rearing areas for fish and, so far as possible, for loss of big game habitat and loss of scenic and environmental values.

Fish life mitigation would include provision of passage and additional production facilities to offset loss of natural production resulting from construction of dams and other structures. The result would be to maintain a production level generally consistent with the potential, under natural conditions, of the stream reaches involved. In consideration of that fact, the extensive new reservoir sport fisheries which would be developed, and the beneficial effects of flow augmentation, overall project impact on fish life would be beneficial. This would apply particularly to anadromous fish. It is recognized, however, that

Table V-15
Projected 2020 needs and comprehensive plan accomplishments

Functions to be Served	Needs 1/ Units	Needs 1/ Amounts	Percent of Satisfaction 2/
Fish and Wildlife:			
Fish:			
Spring chinook salmon	Number of fish	538,000	46
Fall chinook salmon	" " "	1,148,000	80
Coho	" " "	644,000	42
Summer steelhead	" " "	269,000	12
Winter steelhead	" " "	24,000	65
Trout	" " "	5,500,000	122
All warm water	" " "	1,500,000	36
Wildlife:			
Big game	Hunter-days	1,978,000	44
Upland game	" "	1,958,000	69
Waterfowl	" "	603,000	56
Flood Control:			
Annual flood damages	Aver. ann. dollars	213,500,000	93
Effective 3/ storage	Acre-feet	4,005,000	62
Irrigation:			
Water supply	Acre-feet	2,460,000	100
Area irrigated	Acres	1,000,000	100
Land Measures & Watershed Protection:			
Private land treatment	Acres	4,585,000	86
	Dollars	308,000,000	85
Watershed land treatment	Acres	562,000	100
	Dollars	30,200,000	100
Municipal & Industrial Water Supply	Acre-feet	1,613,700	100
Navigation:			
Wood chips	Available tonnage	2,697,000	34
L.P. gas	" "	35,000	100
Greases	" "	50,000	100
Asphalt	" "	369,000	100
Agricultural chemicals	" "	595,000	100
Electric Power:			
Firm energy	Million kilowatt-hours	457,000	100
Peak load	Kilowatts	91,800,000	100
Water-Related Recreation			
Resource capacity	Recreation-days	60,592,000	127 4/
Facilities	" "	60,592,000	117 4/
Water Pollution Control	Flow, cfs 5/	7,500	91

1/ *From Part III of this appendix, and summarized from functional Appendixes D through L.*
2/ *To the degree identified; see Tables V-6 through -14 and accompanying text.*
3/ *Effective downstream from mouth of Clackamas River; includes need for 305,000 acre-feet on that stream.*
4/ *Basin arithmetic total; there would be a shortage in the lower subarea.*
5/ *For Willamette River in Portland harbor area in August.*

the reservoir fishery environment would not provide for all anglers the same degree of satisfaction as would be obtained from a free-flowing stream. That loss would be offset at least in part by proposed programs for increased fish production, stocking and angler access. In total, the overall comprehensive plan would provide for generally increased levels of fisherman success. In consideration of the fact that these latter programs generally could be put into effect if no new project construction were planned, the overall plan represents a loss of stream-fishing, and an increase in reservoir-fishing opportunity. Nonetheless, particularly for anadromous fish, considerable improvement over present success levels would result, in spite of an increasing number of fishermen.

Wildlife impacts and effects from construction of individual projects generally would be relatively small. Overall, project elements of the plan probably would be detrimental to wildlife. Program and management elements, however, should provide increased usable habitat and production, improved hunter access, and an opportunity to manage distribution of use commensurate with resource availability.

Environmental impacts are inherent in project elements of the plan. Some desirable segments of free-flowing streams and adjacent recreational and environmental resources would be inundated. Some channel reaches, with scenic and environmental resources, would be modified by works for flood control, navigation, and drainage. Those losses would be held to a minimum by management for preservation and protection, and by measures to minimize the impact of proposed construction. Some of the losses would be offset by major improvements in quantity and quality of flow; Tualatin River would be an example of what can be done on west-side streams with low-flow problems. Also, there would be a general overall reduction of flood hazard and provision of additional water for general beneficial use during the low-water season.

Overall, the Task Force believes that plan effects and impacts would be consistent with the initial basic concept--that Willamette Basin is, and must remain, a generally desirable place for people to live, work, and play.

EARLY-ACTION ELEMENTS

Certain complementary and supplemental program and project elements of the comprehensive basin plan are proposed for early action--for continuation or initiation within the next 10 to 15 years.

Selection of programs to be proposed for early action was on the basis of magnitude and severity of needs and degree of service which could be provided. For potential new private-sector projects, it was on the basis of known private interest and apparent capability to construct the project involved and that development would be compatible with a comprehensive basin plan formulated under concepts discussed in Parts I and IV. For potential new agency projects, it was on the basis of needs, degree of service provided, and an indication of probable overall economic feasibility and compatibility with the basin plan.

Each of the potential new agency projects selected for early action will be the subject of additional study and inclusion in subsequent and more detailed reports. Those reports, with recommendations, will be processed through usual construction agency channels. Thus, project text in this report is limited to broad, general, descriptive terms. Programs also are described in general terms, with reference to additional data available elsewhere.

PROGRAMS

Programs proposed for continuation, acceleration, and initiation during the early-action period are described in ensuing paragraphs. Those programs are essential plan elements complementary to early-action project elements. Total, and annual operation and maintenance, costs are shown to the extent identified by the study; those costs include, where appropriate, allowance for continuation and acceleration of ongoing programs and for initiation of new programs.

Please refer to the functional appendixes, D through L, for additional detail on all programs summarized herein except the proposed new environmental management program. The basis for that program is shown in Addendum E to this appendix.

Fish and Wildlife

Early-action elements of the overall fish and wildlife program are summarized as follows. Appendix D contains additional details.

Fish Life

Much of the sport and commercial fishing activity using basin fish resources is supported by on-going fish-production and fish-stocking programs. The resident trout fishery is maintained almost entirely by artificial propagation. Essential complementary programs are those for preservation or attainment of optimum conditions in, and fish access to, spawning and rearing areas for increased natural fish propagation; and for increased fisherman access.

All of those programs should be continued. Some should be expanded and accelerated under the basin plan. Also, there are needs for some new program elements.

a. Fish production and stocking. - These programs include all aspects of hatchery operation, plus use of ponds and impoundments for rearing of juvenile anadromous fish and resident game fish.

Recently adopted fish-production developments have been highly successful. These include adoption of the Oregon Moist Pellet as a standard fish food at all hatcheries, perfection of a recycling system for fish hatchery water, and generally improved hatchery feeding and rearing techniques. All new hatcheries will make use of those developments. Coupled with continued water quality improvement, adequate fish passage, and pond and impoundment rearing, these developments promise capability to maintain present levels of fisherman success and meet some out-of-basin needs.

The existing hatchery program should be supplemented by an extensive program for expansion and replacement or renovation of hatchery facilities. That program would apply to both anadromous and resident game fish hatcheries. It would provide anadromous and resident fish for the pond and impoundment rearing programs, and trout for sport fishing in reservoirs and natural and proposed artificial stream fishing channels.

Pond and impoundment rearing of anadromous fish has been successful at Fall Creek Reservoir and several ponds. Fall Creek and Cottage Grove reservoirs have been selected for operation to provide environments for rearing both anadromous and resident game fish. The

authorized Gate Creek Reservoir, in McKenzie Subbasin, and the early-action Buck Hollow Reservoir, in Coast Range Subbasin, have been selected for rearing anadromous fish. Additional future reservoirs, at which the possibility of impoundment rearing of anadromous fish has been identified, include:

Site	Stream	Subbasin	Plan Status
Little Fall Creek	L. Fall Cr.	Middle Fork	Long-range
Upper Mohawk #2	Mohawk R.	McKenzie	"
Shotgun Creek	Shotgun Cr.	"	"
Wiley Creek	Wiley Cr.	Santiam	"
Sawmill	Crabtree Cr.	"	"
Hamilton Creek	Hamilton Cr.	"	"
Grange	Silver Cr.	Pudding	Early-action
S. Fk. Silver Cr.	S. Fk. Silver Cr.	"	Long-range
Milton Creek	Milton Cr.	Columbia	"
N. Scappoose Cr.	N. Scappoose Cr.	"	"

To supplement the fish production and stocking program by use of all natural resources, under the present streamflow regimen, the Fish Commission of Oregon proposes to accelerate its transplanting, rearing, and stocking program. That program involves transplanting coho and winter steelhead to additional streams, and provides for pond rearing of chinook salmon and winter steelhead and stocking in streams which either do not have runs or have runs inadequate to utilize available spawning areas. Fish for rearing and stocking would be produced by existing out-of-basin hatcheries.

Costs associated with the overall fish production and stocking programs would be about as shown in the following tabulation.

Program	Costs, $1,000 Investment	Annual O&M
A. All existing, to be continued 1/	13,000	1,500
B. Hatchery expansion and facilities replacement:		
1. For anadromous fish 2/	42,000	2,800
2. For resident trout:		
a. Streams and reservoirs 3/	4,000	400
b. Artificial channels 4/	2,000	200
Subtotal, B	48,000	3,400
C. Pond and impoundment feeding and rearing for anadromous fish 5/	-	600
D. Increase natural spawning 6/	-	150
Subtotal, additions	48,000	4,150
Total Program Costs	61,000	5,650

1/ *Costs are for present level of development.*
2/ *At Federal cost, through Bureau of Commercial Fisheries.*
3/ *By Bureau of Sport Fisheries and Wildlife and Oregon State Game Commission.*
4/ *Source not identified; could be in part private-sector funds.*
5/ *$500,000 per year by Fish Commission of Oregon; balance by Bureau of Commercial Fisheries.*
6/ *By Fish Commission of Oregon.*

Major funding for anadromous fish production will be from the Federal government and will involve an increasing number of agencies. In the interest of more efficient fiscal management, all Federal participation funds should be channeled through one Federal fishery agency.

b. Fishing opportunity and fisherman access. - In addition to providing increased production, stocking, and natural spawning, there is a need for increased stream fishing opportunity and fisherman access. This is the principal need for the warm-water fishery, as natural production is expected to be able to satisfy the demand for those fish.

One program would compensate for the loss of free-flowing streams within reservoir limits, and for the posting of private lands along streams to close them to the public. The program would be for provision of artificial cold-water stream channels in an appropriate environment. It is estimated that about 300 miles of new channel would be needed in the early-action period. Natural topographic features would be used to hold construction costs to a minimum. Fish for stocking would be provided as needed under the overall fish production and stocking program. Construction of channels on Federal lands would be cooperated in, to an extent yet to be determined, by the Federal administering agency. Operation could be on a user-fee basis, and there could be an excellent opportunity for private-sector participation.

A complementary program would be for acquisition, by the State Game Commission, of access sites on streams on private lands. This would supplement the provision, by Forest Service and Bureau of Land Management, of access sites on public lands. A total of 350 sites have been identified for acquisition by 1985.

In addition, there is a need for access to isolated oxbow lakes, abandoned borrow pits, and low-elevation shallow impoundments. Access to about one-half of the existing areas should be provided by 1985. Also any new, low-elevation, shallow reservoirs should be

managed and operated for warm-water game fish. User charges could be required to help finance acquisition and management. The Oregon State Game Commission would be responsible for acquisition of access. Because of the user-charge aspect, private-sector participation may be possible in some areas.

Estimated costs for fishing opportunity and fisherman access programs are as follows:

Program	Estimated Costs, $1,000 Investment	Annual O&M
A. Artificial stream channels	3,000	1,800
B. Cold-water fish access sites:		
1. Game Commission	1,500	100
2. Forest Service	750	50
3. Bureau of Land Management	750	50
Subtotal, B	3,000	200
C. Warm-water fish access sites	1,500	100
Totals	7,500	2,100

c. Research. - Continued research in the field of fish management programs also is needed, particularly to develop improved techniques to increase production and reduce production costs. Both Federal and State fisheries agencies would participate. The early-action period funding needs are estimated to be about $250,000 annually.

d. Other Programs. - In addition to the foregoing, there should be a continuation of programs for preservation and augmentation of streamflows. Flows available to Willamette Falls fish-passage facilities should be increased to the order of those shown in footnote 6/ to Addendum A, Appendix D, Fish and Wildlife.

No specific fishery costs have been identified for streamflow preservation programs, which are established in the general public interest by Oregon State Water Resources Board. Flow augmentation costs are included in the cost of the specific storage projects which provide the water. The cost of water quality improvement by pollution control programs, discussed under the program heading Water Pollution Control, also is in the general public interest and not identified specifically with fish life. Eradication costs have not been identified, as the need cannot be accurately forecast.

Wildlife

The basic needs in this field are to increase wildlife populations and provide improved hunter access to those populations, in an environment conducive to maximum enjoyment of the sport. The existing resource and environment do not satisfy the demand, and it is not expected that full satisfaction can be provided in the future.

Programs proposed for wildlife include:(1) overall research, investigation, and education, to determine public preferences and obtain support for appropriate development programs, and for improvement of game management techniques; and (2) acquisition and development.

a. Research, investigation, and education. - These new programs, by Oregon State Game Commission, would serve two basic purposes. One would be to determine public preferences for and reactions to various management (and possibly development) programs, and to develop public support for appropriate programs. Means of implementation would have to be determined in more detail, but costs would be in the order of $750,000 initially plus $10,000 annually over the early-action period.

The other would be to predict and evaluate the effects of habitat manipulation, game-harvest control, and other management techniques. This program would be used for deer, elk, some upland game, and migratory birds. The necessary investigations would be made by use of a computerized simulation of wildlife populations and related factors. Estimated costs would be about $567,000 initially plus $30,000 annually for operation and maintenance during the early-action period.

b. Acquisition and development. - This program would complement and make use of data and criteria developed by research and investigation programs. It constitutes a major expansion and acceleration of past acquisition and development practices, for which no cost summary is available.

(1) Flood plain lands. - Undeveloped or unused flood plain lands with high potential for producing wildlife would be identified and acquired. Acquisition, in some cases, could be concurrent with acquisition of Willamette Greenway (Recreational Waterway) lands. The early-action portion of the program probably would involve acquisition of 10,000 acres of land.

Initial investigations of potential acquisition sites would cost about $25,000. Acquisition and construction of necessary facilities would cost about $1 million. Annual operation and maintenance would cost about $20,000 when all lands had been acquired. The Game Commission would have primary responsibility for this program.

(2) Pigeon springs. - This program by the Game Commission would consist of a survey of all pigeon springs in the basin, and leasing and development of about 23 areas for public use. Initial costs would be about $10,000 for investigation and $29,000 for construction; annual leasing and operation and maintenance costs would be about $12,000 and $5,000, respectively.

(3) Waterfowl refuges and management areas. - This program would include acquisition and development of three tracts of land of 2,000 to 4,000 acres each. Those tracts, located on the valley floor, would provide waterfowl refuges, nesting, resting, and feeding areas, and public shooting grounds. Estimated costs are $10,000 for investigations, $1,600,000 for acquisition, and $100,000 annually for operation and maintenance. This program, which would be the responsibility of Oregon State Game Commission, may involve consideration of waterfowl use as an alternative to channel work for flood control and drainage.

(4) Hunter access to farmlands. - Under the proposed program, contracts would be executed with landowners to secure free access for hunters in exchange for State Game Commission control of hunting pressure, trespass, and vandalism. An estimated 300,000 acres throughout the basin could be placed under contract. Estimated costs are $75,000 for investigations and $72,000 for annual operation and maintenance.

(5) Hunter access to private forest lands. - Under the program, contracts would be negotiated with timber companies and farmers to provide free hunter access in exchange for State Game Commission control of hunter dispersal, trespass, and vandalism. About 1.5 million acres of forest land in 16 localities could be included in this program. The estimated initial cost would be $25,000 for investigations. Annual operation and maintenance costs would be $100,000, mostly for posting and patrolling.

(6) Fern Ridge Reservoir levels. - Under this program, the water level in Fern Ridge Reservoir would be held at a stable level from about May 1 to about July 1 to enhance conditions for waterfowl

production. This would be accomplished by the Corps of Engineers, without specific wildlife cost, incidental to and consistent with project modification to resolve the recreation problem discussed with respect to the Fern Ridge Reservoir project. Planning for that modification will include determination of any costs to be allocated to wildlife enhancement.

(7) Fern Ridge water management. - This program might be alternative, to a degree, to water level stabilization. It would provide for a system of dikes and canals for orderly water management and distribution in waterfowl management area marshlands at Fern Ridge Reservoir. Accomplishment by the Oregon State Game Commission would require negotiation of necessary agreements and use permits with the Corps of Engineers. Consideration would have to be given to any loss of usable storage space, and to effects on other uses of the reservoir and adjoining private lands. Estimated initial costs are about $15,000 for investigation and $200,000 for construction. Annual operation and maintenance costs would be about $8,000.

Flood Control

Programs for reduction of flood damages include streamflow forecasting and land measures and watershed protection, discussed separately in subsequent text; small-project construction; emergency protection measures; and regulation of flood plain use. All of these programs are available under existing authorizations.

Small Projects Programs

Standard nationwide programs of USDA and the Corps of Engineers, under general continuing authorizations, provide for construction of small projects. Other general continuing authorizations provide for channel clearing and snagging; and for protection of highways, highway bridges, and public works. Plans for USDA small projects for early action under the PL 83-566 program are discussed under the subsequent Projects heading in this section of Part V. Work by the Corps under small-projects authorization is planned on a case-by-case basis, as needs arise, and is not included in this report. Existing improvements under the programs are listed in appropriate project summaries.

Emergency Programs

Programs available to the Corps of Engineers for emergency action to avert flood disasters or to repair or restore damaged flood control

works are available, to be used as needed. Similarly, disaster programs administered by the U. S. Department of Agriculture, for rehabilitation of farmlands and restoration of flood damages, are available as needed. Because of the emergency nature of the work involved, no reasonable estimates of future cost can be made.

Flood Plain Use Regulation

The basin plan includes acceleration of the existing locally accomplished program during the early-action period to cover all of the basin flood plain. Cities and counties would assume responsibility for adopting comprehensive land use plans and enacting satisfactory flood plain regulations. Use of the conventional floodway and floodway fringe regulatory device would reserve sufficient carrying capacity for the exit of 100-year flood flows and control water-entry elevations of development in the adjoining fringe areas. Locally enacted regulation under the plan should be flexible. On that basis, additional development and use of flood plain lands could be realized consistent with provision of additional structural control by other plan elements.

Information on file with Federal agencies with primary responsibility for flood control would provide a generally adequate basis for local drafting of comprehensive land-use plans for most of the area influenced by floods. However, the formal public information and support provided by flood plain reports provide a sound technical basis for the preparation and implementation of acceptable regulatory ordinances.

Flood plain information reports and technical assistance in flood plain management including flood proofing of structures assist in regulation of flood plain use. Those services are provided under cooperative programs of the Corps of Engineers, Soil Conservation Service, and U. S. Geological Survey, acting in coordination with the State. Acceleration of those programs to a level to achieve the goal of permitting regulation of use of the 100-year flood plain would result in total program costs of about $3 million during the early-action period. No estimate of local costs associated with zoning and enforcement are available nor have costs been estimated for other measures such as flood insurance and tax relief which indirectly, through economic incentives, encourage public acceptance of regulation.

The initial costs associated with new industrial, commercial, and residential development probably would be greater with regulatory zoning than without. However, no mechanism has been devised for estimating such an increment of cost. While initial development costs would be higher, economic costs associated with overall development in the flood plain would be reduced by appropriate regulation.

Irrigation

Programs for assistance in development of irrigation include: (1) technical assistance, cost sharing, and loans, under various programs administered by agencies of the Department of Agriculture; (2) cost sharing on multiple-purpose features, and loans on irrigation facilities, in small irrigation projects under Public Law 84-984, as administered by the Bureau of Reclamation; and (3) sale of irrigation water in Federal reservoirs, also administered by the Bureau of Reclamation. These programs are of assistance primarily to those individuals and small groups that construct irrigation systems through private initiative and investment.

Estimates of future irrigation indicate that some 47,000 acres will be developed by the private sector during the early-action period. Water sources utilized will consist of ground water, farm ponds, natural flow, and storage in Federal reservoirs. The cost of developing the source and delivery to the farmstead could vary from practically nothing to as much as $1,000 per acre depending upon distance of lands from source, elevation of land above source, and type of service provided. Total cost of the early-action increment of private development is estimated at $23.5 million. Annual operation, maintenance, and replacement costs would range up to $20 per acre exclusive of on-farm costs. Assuming an average of $10 per acre per year, the annual OM&R cost for the early-action increment of private irrigation development would be about $470,000.

The Department of Agriculture administers several programs designed to assist private sector development. The Agricultural Conservation Program, administered by the Agricultural Stabilization and Conservation Service, provides cost sharing to individuals and small groups for construction of certain irrigation facilities. Federal investment under this program is estimated at about 10 percent of the total invest-

ment cost. The Water Development and Soil Conservation Loans program, administered by Farmers Home Administration, makes loans for development of irrigation and drainage systems. The repayment period is 40 years or less. The Soil and Water Conservation Districts program, by memoranda of understanding with the Soil Conservation Service, provides technical assistance to participating individuals and groups in applying conservation practices. Cost of this program is shown in the following section on Land Measures and Watershed Protection.

Two assistance programs, administered by the Bureau of Reclamation, are available to private irrigation development. The Small Reclamation Projects Loan Program, Public Law 84-984, provides loans and grants up to $6.5 million on total project costs not to exceed $10 million. A substantial portion of project costs must be for irrigation works; however, other functions can be included as well. The repayment period for loans is 50 years or less. Although no loans have yet been made in the basin under this program, several groups have recently been considering its use. The other program involves the sale of irrigation water in Federal reservoirs constructed by the Corps of Engineers. Water released from storage now is available, at a nominal charge, to individuals and small groups through water service contracts with the Bureau of Reclamation. The cost of administering these programs largely involves preparation of contracts and annual billing reports, which to date have been relatively small.

Land Measures and Watershed Protection

Land measures and watershed protection programs of the Departments of Agriculture and Interior and the State of Oregon have been in successful operation for many years. Because of increasing population and economic development, the intensity of needs for those programs has increased. Appendix G shows details of the overall program proposal, the agricultural and forestry elements of which are summarized below, except for irrigation previously discussed.

Agricultural Programs

There is no strictly objective method for projecting demands for or accomplishments of conservation measures on private lands. The need for conservation measures is related primarily to the compatibility of the land use with the capabilities of the land; the rate of accomplishment depends principally on landowner's decisions as to voluntary participation. Application of conservation and utilization measures on private lands involves individual and group action. Assistance, in various forms, is provided by the U. S. Department of Agriculture, the State Engineer's office, the State Soil and Water Conservation Commission, and by some counties.

Table IV-1 of Appendix G shows an unmet need of about $61 million for service by roughly 125 land treatment practices by 1980. It shows that about $4.25 million of that need should be satisfied by Federal program assistance. County-wide land-use plans were not available for use in this multiagency study, but now are being developed. Those plans will provide a basis for assessing changing conservation needs, particularly for those areas which will be converted from agricultural to urban or suburban uses.

Group enterprise activities at 133 locations would provide for land drainage, irrigation, channel clearing, channels and streambank shaping and stabilization, and dike and levee construction. Total cost would be about $7 million, of which about $3 million would be non-Federal.

Small watershed projects, of which 26 are proposed for early action as described herein, include about $10 million of land treatment program activities. About $1.9 million of that total would be for technical assistance under Public Law 83-566. Those costs are included in the subsequent showing of individual project costs, and are shown here only to provide information on total program funding requirements.

Excluding the $10 million associated with watershed projects, agricultural programs during the early-action period would cost about $11.25 million, of which about $8.25 million would be Federal cost.

Forestry Programs

Ongoing forestry programs at Federal, State, and private levels generally are adequate for meeting future needs of the basin. Public lands involved include those in National Forests, managed by USFS; public domain and Oregon and California Revested Lands, managed by BLM; and minor amounts of State and county lands. Unmet needs to be satisfied by program activities, and the general nature and estimated costs of programs involved are summarized in the following subparagraphs.

a. Forest Service. - The Forest Service programs would involve several activities. Included are: (1) land restoration practices, at a cost of about $2 million; (2) fish and wildlife improvements on lands, lakes, and streams, including inventories and plans, at a cost of about $1 million; (3) camp and recreation facilities on about 330 acres at a cost of about $0.6 million; (4) soil and water research at a cost of about $1.6 million; (5) soil surveys and soil management services at a cost of about $0.3 million; (6) initial research on fish and wildlife habitat at a cost of about $0.4 million; (7) acceleration of hydrology program at about $0.2 million; and (8) provision of about $0.2 million as matching funds to the State of Oregon for improved management on State and private lands. Those program activities, in total, would cost roughly $6.3 million by about 1980.

b. Bureau of Land Management. - Most BLM activities will be associated with timber harvest and road construction. Activities involved include: (1) restoration and site improvement works on about 12,600 acres, at a cost of about $0.3 million; (2) road maintenance, at a total cost in the order of $0.6 million; (3) development of streamside recreation facilities on 760 acres in the Yamhill drainage, at a cost of about $1.1 million; (4) soils surveys on about 180,000 acres, at a cost of roughly $0.1 million; and (5) hydrologic research related to prevention of soil erosion, at a cost of about $0.3 million. Total early-action period costs would be in the order of $2.4 million.

c. Oregon State Department of Forestry. - The State of Oregon, on a matching basis with the Forest Service, currently provides about 4 man-years annually in carrying out a technical service program to small private woodland owners within the basin. Additional funding estimated

at about $0.2 million would be required to meet the recommended 11-man-year level by 1980. The Department also administers a somewhat scattered pattern of State-owned forest lands within the basin and provides fire protection to all private, State, and BLM forest lands within the basin. Those programs are generally adequate for meeting anticipated future needs.

Municipal and Industrial Water Supply

No specific water supply programs are identified in Appendix H. However, planning funds and construction loans are available to communities, from the Farmers Home Administration and the Department of Housing and Urban Development, for water supply development. Except for such planning funds, and the long-term repayment provisions in the Water Supply Act of 1958, there is no provision for specific Federal water supply assistance. However, the ground water investigation and stream-flow records programs of USGS and the State Engineer, the water standards program of the State's Environmental Quality Commission, the water treatment facilities program of the State Board of Health, the water hygiene activities of the U. S. Public Health Service, and the Water Resources Activities program of FWPCA contribute to knowledge of water availability and to quality of available supply. No program costs are assigned specifically to water supply.

Appendix H shows that the total available water supply, from all sources, will be adequate to meet projected future needs. Most of the additional needs are expected to be met by use of storage and other sources of generally poorer quality than those now in use. Under those conditions, and even though some communities may choose to develop individual supplies, the principal considerations will be those of water quality and the indicated need for purification activities.

Appendix H identifies an early-action need for non-Federal investment of about $21.2 million in water treatment facilities. There would be an associated operation and maintenance cost of about $1.8 million annually by the end of the period. No costs are shown for pumping, diversion, or distribution systems.

Navigation

There is an existing program, under Section 3 of the River and Harbor Act of 1945, for Federal clearing and snagging in the interest of navigation. That program now is used, as warranted, on a case-by-case basis. It remains available to be used as needed and justified. No specific early-action needs or costs are identified.

Also, there is a program under Section 107 of the River and Harbor Act of 1960, as amended, for construction of small navigation projects. Although it has not yet been used in Willamette Basin, that program may be appropriate for use in the future at some locations in the study area. Because it would be applied on a case-by-case basis, with specific determinations of Federal and non-Federal costs in each case, no early-action cost estimates are available.

The flow-preservation programs of OSWRB are essential to maintaining flows required to supplement authorized open-river works for navigation. None of the costs of the Board's overall programs have been identified specifically with navigation. Also, continued development and use of navigation will involve unevaluated local expenditures for additional mooring, storage, transfer, and related facilities, as needs develop, along the channel.

Power

Appendix J identifies a considerable number of potentials for power generation. Table V-4 summarizes power elements of the comprehensive plan.

The overall Federal-private provision of transmission facilities and regional interties, and the coordinated Federal-private planning for power needs satisfaction, constitute an essential ongoing program. Within that program, research is underway on several items pertinent to satisfying overall power needs at minimum cost and with minimum environmental impact. Included are studies of high-voltage and direct-current transmission, underground transmission, super-capacity conductors, and cryogenics as a means of developing super-capacity conductors. Considering the potential impact of findings from those studies, no specific decisions as to plant siting or transmission type, location, or

corridor areas should be made at this time. Also, as mentioned on page III-36, there is a need for a State-local thermal plant siting entity which, if created, should participate in or make use of data from those studies.

Costs for the overall ongoing program, part Federal and part non-Federal, are on a regional basis. The program must be continued and accelerated, throughout the early-action period and beyond, if the projected 34-fold increase in power needs of the basin, over those of 1965, is to be met.

Recreation

A part of the annual need for more than 14 million additional user days by about 1980 would be met by water projects. Coordinated programs, however, would be required to provide a proper balance of types and locations of recreation experience to accommodate more than 10 million recreation days of use. This would require full use of the capabilities of the private sector and of local, county, state, and Federal groups and agencies. Coordinated, cooperative planning for programs must include consideration of the amount of funds available to individual agencies, and of the use made of existing, authorized, and new water storage projects. Many of the ways and means which the agencies can incorporate into their programing to intensify needs satisfaction are outlined in Part IV of Appendix K.

The total cost of program activities during the early-action period is estimated to be about $30 million. Corresponding annual operation and maintenance costs would be about $350,000.

No information is available as to investment in, or cost of operating and maintaining, the existing installation. Since most agency planning is concerned with a much larger total area than Willamette Basin, priorities must be set by each agency after consideration of all needs including those outside the basin. Some agencies may find it difficult to obtain the necessary funding of Willamette Basin programs because of pressing needs elsewhere. Under those circumstances, a reevaluation and reassignment of agency responsibilities would be needed to take up the slack. On the other hand, water storage projects

may provide for more recreation opportunity than was estimated when determining agency responsibility through programs. This, too, could cause a shift in the magnitude of some programs. However, the wide range of type and location of recreation experiences which should be provided precludes satisfaction by developments at water-storage projects alone.

Coordination of all of those aspects of recreation programs and activities would involve both governmental entities and the general public. A coordinating committee with such representation and for that purpose should be established, either by the Oregon State Highway Department's Parks Division, consistent with its overall Parks Plan, or by the Bureau of Outdoor Recreation under its overall planning and coordination responsibility, or by both acting in cooperation. Membership should include all of the land management, water, and related resource agencies and one or more appropriate public representatives.

Following is a discussion of some of the individual program categories with regard to emphasis and direction which would best satisfy the recreation needs of the basin.

Private Sector

The private sector has the potential for a considerable degree of needs satisfaction, particularly with respect to recreation development in the area west of Willamette River. The private program should be developed in consultation with agencies and representatives of local, State, and Federal governments. This could be done through the proposed environmental-recreation coordinating committee. It should lead to development of cooperative programs under which needs will be met and in which appropriate private sector investment can be financially rewarding. Private recreation developments in the western portion of the middle and lower subareas would have a maximum of prospect for profit and a minimum of competition from existing and potential new Federal water projects. No definite cost can be estimated for potential private-sector development.

City and County Governments

In general, city government programs satisfy high density day-use needs. Responsibility for such service will be highest west of Willamette River and in the middle and lower subareas, where the greatest needs now exist.

Local programs could include land use zoning, provision of riding and walking trails, and intensive-use facilities such as swimming pools, parks, and playgrounds. Emphasis should be placed on early acquisition of needed lands where opportunities otherwise would be lost. Local governments should increase the tempo of comprehensive recreation planning, including all the necessary elements to lead them to an action program. There is a need for local government officials to work with the State to see that appropriate information is incorporated in planning for State recreation development.

In general, county programs would meet needs for neighborhood-community types of recreation, and provide for day-use regional types of recreation within 1-hour travel distance from urban centers. Programs in counties with a maximum of recreation potential could be geared to attract use from out of county for economic stimulus and to help satisfy needs of other parts of the basin.

Green space, open space, and parkway development should rate high priority in the county program. This is particularly important along the rivers and streams where rapid development is occurring. The counties have the best opportunities for the protection and preservation of those very desirable areas. Counties containing land west of the Willamette have considerable need to preserve those areas, since very little State and Federal land is available there.

Cooperation between county administrators and the educational system would facilitate mutual use of facilities and resources. Schools could use county facilities for conservation-education activities, while the county could utilize school facilities, particularly during summer months, for county recreation programs. The counties should begin planning now for establishing "conservation parks," which would retain natural areas for enjoyment and education. The planning must be done now to insure preservation of those areas in the face of urbanization and industrialization.

There are good possibilities for county development on Federal land within the basin. Counties' programs should explore the idea of county development on National Forest lands through agreement with the U. S. Forest Service. The counties should also find out what lands, under the jurisdiction of the Bureau of Land Management, may be available under the Recreation and Public Purposes Act[1/] and the Small Tract Act.[2/]

Counties' programs should recognize and encourage commercial and other private recreation development. Cooperation should be carried out to avoid undesirable competition and unnecessary expenditures of public monies.

State Government

Overall, the State should take action leading to the acquisition and development of areas that are: (1) near urban areas; (2) of high recreation and/or environmental quality, preferably associated with water bodies of high quality; (3) suitable for multiactivity and multiseason use; and (4) able to handle large numbers of people. Particular emphasis should be given to the middle and lower subareas and the vicinity of the population centers of Willamette Valley.

The State should extend the Willamette River Park System program over a long-range period of time and provide for increasing public use and recreational enjoyment of Willamette River for the future.

Environmental values of State interest and responsibility in Willamette Valley should be identified and action taken to protect and enhance their recreational values for the public. These would include scenic areas along major highways, wild or scenic rivers, historic sites, recreational trails, and new park areas.

Federal Government

Federal construction and resource agencies also have responsibilities in the overall recreation program. Federal construction agencies should recognize, and provide for as appropriate, the potential changes in recreation demand mentioned in Part III of this appendix. In summary, the parts those agencies should play in the program are:

1/ *Act of June 1, 1938, (52 Stat. 609) as amended.*
2/ *Act of June 14, 1926, as amended.*

a. Corps of Engineers. - The Corps should provide, in addition to recreation facilities at new projects and under existing recreation programs, additional recreation development to utilize the potential represented by existing Corps of Engineers reservoirs and new development at authorized reservoirs. Also, the Corps should review its authority with respect to land and water resource management with the object of determining what can be done, either by way of implementation of existing authority or through enactment of additional legislation, to respond to increasingly serious environmental problems. The Corps of Engineers program should insure that water resource development projects retain, restore, or enhance natural channels, vegetation, and fish and wildlife habitats on rivers, streams, and creeks to the maximum practicable extent. The Corps program should incorporate in project evaluation existing policy and regulations concerning environmental considerations. Proposed projects within the basin should be reviewed to determine their effects on the environment and include measures to mitigate environmental loss and to accomplish any possible enhancement. Particular attention should be given to channel improvement projects such as those planned for Tualatin and Pudding Rivers. Issuance of permits for dredging and other work in navigable waters should continue to be on the basis that potential damage to fish and wildlife and environment would be prevented or minimized. Also, the Corps should periodically review the operating plans for its system of reservoirs to make sure that the system's potential is used in the best manner possible to satisfy changing and growing needs for recreation as well as other functions.

b. Bureau of Reclamation. - The Bureau should take action similar to the Corps of Engineers with respect to authorized and new projects. In addition, the Bureau should investigate all possibilities of incorporating outdoor recreation developments into water distribution systems. Irrigation canals offer opportunities for parallel hiking and riding trails, and similar or related environmental enhancement measures. Particular attention should be given to potentials and needs of the Coast Range subbasin where water resources, as a basis for serving recreation needs, are lacking.

c. Soil Conservation Service. - The SCS should continue to encourage private development of recreation facilities, as well as recreation

development at PL 566 projects. Farm pond recreation is needed, particularly west of Willamette River. Hunting, fishing, and vacation home ventures should be promoted. In addition, and also of benefit to recreation, the Soil Conservation Service should emphasize promotion of higher quality overall rural environment. This could be done through the use of "conservation showcase" projects. These would show the most successful land-use practices that not only enhance the natural beauty but also protect and improve the soil condition and the water supply. Tualatin and Coast Range Subbasins offer good possibilities for this type of venture.

Existing technical assistance programs should be expanded, particularly to assist in preserving working farmlands in areas of high-class land which might otherwise be taken over by residences and industry. Future outdoor recreation needs in the basin will be met only if the private sector pursues an aggressive program of recreation development.

d. Bonneville Power Administration should accelerate its program of improving the appearance of transmission lines, substations, and related facilities. Forest land management agencies should be brought into preliminary planning for main transmission line rights-of-way locations, and allowed to impose reasonable conditions for site and alignment selection, in order to preserve high-value forest lands as well as esthetic and related values.

e. Bureau of Land Management should develop facilities to accommodate an additional annual use of about 1 million recreation days by 1980. About one-half of this should be accomplished on recreation development sites such as campgrounds and picnic areas. Most of the remaining development should be minimum facilities for protection and sanitation, and facilities to increase the meaning of the recreation experience.

Since BLM is the only major public landowner west of Willamette River, it should emphasize development there. Particular emphasis should be focused on the middle subarea because of its acute shortage of facilities. Developments should probably be quite modern and offer extra convenience to offset the lack of attractive sites.

Coordinated planning, between the Bureau of Land Management and the Forest Service, is essential to avoid duplication of effort

and to insure the wisest expenditure of public funds to meet the needs.

BLM should investigate the possibility of outdoor recreation developments in cooperation with private landowners; further discussion of this subject is contained in Part IV of Appendix K. That type of venture is needed now in the middle subarea, west of the Willamette, and will be needed in other areas in the future. This is particularly important since much of the land administered by BLM is in areas of intermingled ownership. A good example is the upper portion of Coast Fork Subbasin.

A system of scenic roads and scenic trails needs to be developed on BLM-administered lands. Again, the most acute need is west of Willamette River. However, there is also a need east of the river for interpretive signs, overlooks, and rest stops along scenic roads and trails.

BLM should be cognizant of private commercial recreation operations and offer technical assistance where appropriate. It should also avoid development of public recreation areas which would severely compete with desirable private ventures.

f. U. S. Forest Service should provide for an additional two million visitor days annually by 1980. About one-third of that total should be accommodated by developed recreation sites, with appurtenant facilities. Most of the remaining use would be on Class III, IV, and V lands, and would involve facilities for sanitation, safety, and public understanding and enjoyment. The Forest Service has the natural resources and capabilities of providing for this increased impact. Implementation hinges only on funding. By 1980, emphasis should shift to the middle and lower subareas.

Scenic drives and trails, with markers and interpretive signs, and campfire programs and informative displays at recreation sites, should be increased as needed. Redistribution of use to under-used sites, mid-week and pre- and post-season use, and private development should be encouraged. An inventory of the recreation potentials on closed municipal water supply watersheds should be made as soon as possible to permit planning for recreation as needed.

The Forest Service should investigate the possibilities of cooperative outdoor recreation developments with private landowners, such as public utilities and large timber companies; further discussion

of this subject is contained in Part IV, Appendix K. That type of venture would be extremely important in the long-range picture as resources become increasingly scarce.

The Forest Service should be cognizant of commercial outdoor recreation operations and offer advice where appropriate. It should consider the capacity of commercially developed recreation areas to provide for recreation opportunity in planning construction of facilities.

g. Fish and Wildlife Service, in cooperation with the State fish and game agencies, should program an immediate evaluation of present and potential nonconsumptive recreational uses of fish and wildlife. The recreational importance of those resources for viewing, as a part of the recreational environment; for nature study; for photography; etc., is not fully understood by most recreation planners. The evaluation program should be aimed at determining the total demand for and value (tangible and intangible) of such uses as a joint aspect of fish and wildlife and recreation.

h. Bureau of Outdoor Recreation should expedite recreation and environmental studies of potential early-action projects in the plan. It should become more deeply involved in project plan formulation in order to promote greater consideration of environmental and recreational values.

i. National Park Service has an important program established by PL 89-665 (National Historic Preservation Act), which authorized: (1) matching grants to the states for preparation of statewide historic preservation plans, (2) matching grants for acquisition and rehabilitation of historic sites and structures, and (3) expanding the National Register of Historic Places. That program has never become fully operational because of lack of funding. The Act will expire at the end of FY 1970. If its aims are to be accomplished, it would have to be extended and funds provided for Federal participation along with the State, which is presently proceeding on its own. Also, in cooperation with BOR to whatever extent may be consistent with agency and departmental policy, NPS should continue to serve the Federal construction agencies in the areas of archeology and recreation planning.

Water Pollution Control

Appendix L, Water Pollution Control, proposes an overall program of activities for pollution abatement and water quality maintenance for the basin. Elements of that program are considered optimal at present, but subject to change with technologic advances and increased knowledge of the river. An essential prerequisite to the program will be a mechanism for coordination of the activities of all agencies which have responsibilities under the program. Of those agencies, the Oregon State Department of Environmental Quality (DEQ, formerly OSSA) and the Federal Water Pollution Control Administration (FWPCA) are paramount at State and Federal levels.

The basic element of the program is a high level of at-source waste treatment, by all municipalities and industries. That work, which constitutes an acceleration of an ongoing program, would cost about $105 million during the early-action period. Of that total, at least 30 percent should be accomplished as soon as possible. By the end of the early-action period, operation and maintenance costs for the new work would be in the order of $7.5 million annually.

The construction cost of new treatment facilities would be the joint responsibility of private industry and all levels of government. Subject to availability of funds, construction grants may be obtained from State and Federal sources for municipal treatment facilities.

There are many other elements of the overall program. These include: (1) flow regulation (augmentation), to the extent justifiable as a supplement to high levels of waste treatment; (2) completion of interceptor sewer facilities by the City of Portland; (3) management of wastes from houseboats and shipping, by DEQ and FWPCA; (4) control of fertilizers and commercial toxicants, by the USDA; (5) soil stabilization, by USDA and by construction agencies at job sites; (6) control of animal waste discharge to water bodies, by DEQ; (7) control of urban runoff, by the City of Portland under an adopted budget; and (8) a large number of management practices, as discussed in Part IV of Appendix L.

In general, flow augmentation could be provided by joint use of storage space required for flood control. However, the authorization

for the USBR Tualatin Project includes a requirement that there be reimbursement for joint-use-storage costs allocated to flow augmentation. Individual agency reports recommending project authorization will show any allocation of joint costs to that function. No specific or overall costs are shown in Appendix L for the other elements listed above.

Environmental Management

As one element of program management, preservation and protection of selected streams, stream reaches, and related adjoining lands is an essential part of the plan. The purpose of the program would be to increase the level of protection against factors detrimentally affecting the environment.

In the broader total view, the management program would include the improvement of water quality; provision of water supply; preservation or protection of important biological, visual, and cultural resources; control of solid and liquid wastes; recreation; flood and erosion control; and related items. Thus, with stream preservation as a key element, the program would focus on preservation, protection, improvement, and provision of opportunities for use of water to serve esthetic and utilitarian needs.

Streams recommended by the Recreation Committee for environmental management are discussed in a Committee letter reproduced as Addendum E to this appendix. Only the specifically named streams (not unnamed tributaries thereto) are involved. The recommendations do not apply to those segments or reaches of named streams which contain existing or authorized projects. Neither do they imply or state a recommendation for acquisition, condemnation, destruction, or removal of any existing development; or any lessening of the necessity for consideration of environment on other streams or in other areas. However, consideration should be given to any appropriate and timely action, on the part of the owners of lands and developments on streams to be managed for environment, which would aid in achieving ultimate conformity.

The proposed protection would involve preservation of flows to the extent naturally available, or as can be provided from tributary storage, up to amounts stated in Addendum A to Appendix K. Also, it would involve management of adjoining lands to protect scenic areas and

preserve or enhance the overall streamside environment. Management of public lands involved would be for preservation and protection, recognizing the related needs of fish and wildlife and for public use of those resources. Private lands would continue to be managed by landowners, who would be encouraged to consider environment and overall desirability of maintaining a natural and pleasing appearance.

Program implementation would be by water and land management agencies, State and Federal, respectively; Soil and Water Conservation Districts; and private owners on a cooperative and coordinated basis.

The State agency directly involved is the Oregon State Water Resources Board. That agency, acting under ORS 536.300, has adopted programs for the use of the waters within Willamette Basin streams. Those programs are supported by State Law, but can be modified. Modification entails a showing that change would result in the highest and best use of the water for the benefit of the State as a whole. The Board's program provides for maintenance of minimum perennial streamflows, and specifies the beneficial ways in which the water may be used. Any relaxing of the protection afforded by the State program would require justification before the Board. Procedures for such action are embodied in the Board's normal operation under Oregon law. The classification-of-use and flow-preservation actions by the Oregon State Water Resources Board are consistent with the preservation-protection management concept. Some expansion of the Board's program would be necessary to include all of the streams and stream reaches recommended in this report. That expansion would require the sort of showing, before the Board, as for any other action. The subsequently discussed multiagency coordinating group should work with the Board to initiate appropriate action.

The Federal agencies which would be responsible for land management under the proposed program are the U. S. Forest Service and the Bureau of Land Management. Appropriate management can be accomplished within the provisions of existing authorities under which those agencies function.

The implementation of the proposed preservation and protection program on certain streams would require that the agencies involved cooperatively develop management plans to achieve the goals of the program. The coordination should include Federal and State agencies

and representatives of local entities. The coordinating committee discussed under Recreation Programs includes such representation and should accept the management coordination responsibility. Where complete implementation of the preservation and protection program would involve private land, an effort should be made to gain support of the landowner. Planning should be done in cooperation with the private landowners to determine the best methods of protecting the values involved. Soil and Water Conservation Districts, which exist in each of the basin counties, should be brought into the planning for private implementation, with appropriate emphasis on total land areas as well as on streamside lands. Those districts could coordinate land management aspects of the program, on private land, with those of the public land-management agencies and assist in determining best methods of protecting the values involved.

As a part of the proposed program, studies of the full range of values present, and of potentials for all uses, should be made and kept current. With that information, decisions for change, either for development or for permanent preservation, could be made as appropriate. In the interim before completion of such studies, no development or use should be permitted which might impair scenic or unique natural environmental values on the streams involved, or reduce or eliminate the option of choice among alternatives.

Program costs would include a minor amount annually for coordination and administrative activities. The cost of proposed studies for evaluation of environmental values, which should be accomplished as soon as possible, has not been estimated. However, in view of the scope of normal activities of the resource agencies involved and the data now available, total cost should be minimal. Studies of developmental potential would be made, as at present, under the normal programs of the construction agencies.

The streams and/or reaches recommended for inclusion in the program are listed in Table V-16. The areal extent of lands which should be managed under the preservation concept would be determined by the interagency-local coordinating committee on the basis of conditions along the individual streams and reaches. In making such determinations,

consideration would be given to land ownership, public or private; topography, as related to visibility from the stream; and overall character of the areas involved.

The exceptions shown in Table V-16 are the result of judgment decisions, by the multiagency plan formulation group, based on comparison of individual elements of separately prepared preservation and development proposals. Table IV-15 shows, for comparison with exceptions listed in Table V-16, the potential projects set aside in favor of the management program.

Table V-16
Streams selected for environmental management

Subbasin and Stream	Exceptions
Willamette River	Exist. projects; early-action nav. channel mod., basin-system channels, and development of recreation potentials.
1, Coast Fork:	
Coast Fk. Will. R.	Exist. projects; early-action basin-system channels
Mosby Creek	Long-range Abrams Reservoir
2, Middle Fork:	
M. Fk., Will. R.	Exist. projects; early-action basin-system channels
N. Fk. M. Fk. Will. R.	None
Diamond Peak Wilderness streams	None
Waldo Lake Rec. Area streams	None
3, McKenzie:	
McKenzie R.	Exist. projects; early-action basin-system channels
White Branch Cr.	None
Horse Cr.	None
French Pete Cr.	None
S. Fk. McKenzie R.	Exist. and auth. projects
Mt. Washington, Three Sisters Wilderness streams	None
4, Long Tom:	
None	
5, Santiam:	
Santiam R.	Exist. projects; early-action basin-system channels
N. Santiam R.	Exist. projects; early-action basin-system channels
L. N. Santiam R.	Early-action Lyons Reservoir
Breitenbush R.	None
S. Santiam R.	Exist. and auth. projects; early-action basin-system channels

McDowell Cr.	None
Wiley Cr.	Long-range Upper Wiley Creek Reservoir
M. Santiam R.	Exist. project
Calapooia R.	Auth. Holley Res., including downstream channel
Mt. Jefferson Wilderness streams	None
6, Coast Range:	
Yamhill R.	None
Rickreall Cr.	Long-range Dallas Reservoir
Marys R.	Early-action Noon Reservoir
7, Pudding:	
Molalla R.	Early-action Dickey Bridge Reservoir, basin-system channels
Butte Cr.	None
Abiqua Cr.	None
8, Tualatin:	
Tualatin R.	Early-action Gaston Reservoir, Tualatin channel
9, Clackamas:	
Clackamas R.	Exist. projects; long-range Big Bottom Reservoir, local FC under Sec. 205
Eagle Cr.	Long-range Eagle Creek Reservoir
Collawash R.	None
Mt. Hood Wilderness and Rec. Area Streams	None
10, Columbia:	
None	
11, Sandy:	
Col. Gorge Rec. Area	None

Local steps are being taken, with the approval of the Governor of Oregon, to proceed with a basin-wide study of environmental potential and needs. The Columbia Region Association of Governments and the Mid-Willamette, Linn-Benton, and Central Lane Councils of Government, working with representatives of industry and other interests, are spearheading the action. Information on this environmental management program and on the overall comprehensive plan will be available to the local group for use in their study. Such information includes the data in this appendix, as well as all of the environmentally-related data and recommendations in the functional appendixes.

Precipitation Data Reporting Network for Willamette Basin

The existing network of precipitation reporting stations, described in Appendix B, provides adequate areal coverage for the preparation of

public and operational streamflow forecasts under the present conditions of basin reservoir development. However, as early-action storage elements of the comprehensive basin plan are constructed, additional precipitation reports will be needed to define reservoir inflow at individual project locations.

A completely automated, computer readout, hydrometeorological reporting system (snow data, river stage, water temperature, soil moisture, precipitation, air temperature, wind, etc.) has been planned for Willamette Basin as part of a multiagency Columbia River Basin Network and is programmed for installation by 1975. Essential segments of existing Willamette Basin telemetered and non-telemetered networks operated by all governmental agencies could be combined into the multiagency Columbia River Basin Network, on a cost-sharing basis, with data retrieval possible for all interested parties. Basic funding for the Willamette Basin portion of the larger network would be provided by the Corps of Engineers.

The U. S. Soil Conservation Service is currently operating a telemetry network of four snow data stations in Willamette Basin. Each station reports water content of snowpack and has the capability of reporting four additional parameters (air temperature, precipitation, solar radiation, wind, etc.). The system is completely automated, with computer readout, and the data are available to all interested parties. Plans call for expansion of the network to include nine additional data sites. The estimated cost for the additional sites would be $65,000 for installation plus $15,000 per year for maintenance.

Air Pollution Control Support

To meet the increasing need for total environmental quality control in Willamette Basin will require support programs for the measurement of several meteorological parameters within and at higher elevations on the periphery of the basin. For example, ESSA's Weather Bureau is planning instrumentation of 25 wind, temperature, and humidity remote stations located at 2,000 to 4,000-foot elevations throughout the state. Sites for monitoring stations in Oregon have not been pinpointed, but there is need for a substantial number to cover Willamette Basin where trapped air regularly becomes a "pollutosphere." It is possible that several of the sites proposed for telemetered precipitation data would

be compatible with these meteorological measurement stations. Siting and costs for Willamette Basin are yet to be determined.

Radar Weather Surveillance

The use of radar as an important weather observational tool for the detection, early warning, and tracking of severe weather systems has been well established by the Weather Bureau in central and eastern sections of the United States. The expansion of the Weather Bureau's radar network has been proceeding very slowly in the western portion of the United States, although requirements for radar surveillance are high. Radar installations in the western United States, particularly in Willamette Basin, can provide vital observational support to the following weather service programs: Public Service, Aviation Services, Hydrology, Fire Weather, Air Route Traffic Control (ARTC), Air Resource Laboratory, and Applied Studies. Pertinence to the streamflow forecasting program in Willamette Basin would fall into two general categories: (1) flash flood potential advisories in small watersheds, and (2) real-time briefing during general flooding conditions.

Weather Bureau plans for Willamette Basin radar surveillance include the Mt. Ashland site near Medford, Oregon (covering the southern half of Willamette Basin), and joint use of Federal Aviation Administration (FAA) ARTC radars (covering the northern half of Willamette Basin). At present, construction of buildings is nearing completion at the Mt. Ashland site with full operation expected by the spring of 1971. Funding for the implementation of the ARTC radar program is planned within the next calendar year. This joint ESSA-FAA Radar Weather Surveillance Program will provide Weather Bureau capability to monitor FAA radar installations at Klamath Falls and Salem, Oregon, and at Seattle and Spokane, Washington, and thus provide complete coverage of Willamette Basin and surrounding areas.

Daily Streamflow Forecasting

Willamette Basin stream forecasts, made by the U. S. Soil Conservation Service and the U. S. Weather Bureau, Portland River Forecast Center, are made available through the various public communication channels to industries and the general public. That service provides a basis for taking appropriate flood emergency actions. The program

should be continued and expanded, by 1980, to provide around-the-clock streamflow forecasting services for the entire Columbia River Basin. Annual operating cost at the present level is about $220,000, of which the Weather Bureau provides $130,000; the remainder is provided by the Corps of Engineers. The expanded program would cost about $440,000 annually; the Weather Bureau share would be $300,000. Willamette River Basin streamflow needs, while not identified as to cost, are an important part of the regional program.

Seasonal and Residual Water Supply Forecasts

Seasonal and residual water supply forecasts made by the Soil Conservation Service are used by farmers and other water users including municipalities, industries, government agencies and the general public. With an anticipated increase from 244,000 acres to 430,000 acres of irrigated land within the basin by 1980, and 1,000,000 acres by 2020, the forecasting program should be expanded to include additional irrigation water supply and low flow (water right) forecasts. The cost of an expanded program for Willamette Basin would be $50,000 by 1980 and $100,000 by the year 2020.

Mapping

Progress on many of the early-action activities would be advanced by the availability of adequate topographic maps. The USGS mapping program should be expedited to provide complete coverage with quadrangle maps of the 7-1/2 minute series. In areas of flat terrain, 5-foot contour intervals should be provided. Because of the rapid sophistication of physical planning and the continuing nature of the basin comprehensive plan, an early mapping program to provide 2-foot relief in the flat valley floor area might be justified.

Soil maps such as would be prepared under Department of Agriculture programs also are essential to continued detailed planning and development of the comprehensive plan. Also, the adoption of the State plane (Lambert) coordinate system by all concerned, as a basis for electronic data storage and retrieval and for property description purposes, would be desirable. The Metropolitan Planning Commission (Lower Subarea) has done considerable work along those lines.

PROJECTS

Projects proposed for initiation, reauthorization for additional purposes, or operational modification during the early-action period are discussed in the following paragraphs. As was done in describing the overall comprehensive plan, projects studied for this report by individual agencies under Task Force coordination are discussed by groups under agency headings. Part VI contains Task Force conclusions as to possible agency responsibilities for plan implementation. However, final decisions in that regard lie with people in the areas to be served and with the Legislative and Executive branches of State and Federal government.

Projects in the early-action category generally will have to be the subject of additional and more detailed study before specific recommendations can be made for authorizations or reauthorizations. Such studies would be made by lead agencies consistent with discussion herein, or by appropriate private-sector or public non-Federal entities. Those studies would be made in cooperation between and among construction and resource agencies and in coordination with appropriate private-sector and public representatives.

Those studies must recognize and provide for all of the physical, esthetic, and intangible aspects of environmental preservation, recreation, and fish and wildlife preservation and enhancement. Included must be consideration for minimizing channel work impacts by preservation of streambank cover, spawning gravels, and in general as near to natural conditions as possible. Also, recognition must be given to needs for features to compensate for loss of natural production of fish and wildlife. Such recognition and provision, whether or not specifically stated in subsequent project descriptions, must be elements of all future studies and all resulting project plans. Compliance with requirements of Public Law 91-190, the National Environmental Policy Act of 1969, will provide a significant part of the essential coverage.

In addition to the facilities mentioned in the descriptions which follow, each major early-action reservoir project and possibly some of the small watershed reservoir projects would include multilevel withdrawal facilities. Project plans would be developed so as to not preclude future installation of reaeration devices if the need and

justification therefor should arise. Further, estimated costs for major reservoir projects, as presented to the Congress for authorization, would include an allowance for post-construction water-quality analyses.

Map V-1 shows the location of potential reservoir projects. Map V-2 shows the location of the principal flood-control channel projects. The following text describes early-action projects studied by each of the construction agencies.

Existing and Authorized Corps of Engineers Projects

Existing and authorized Corps of Engineers reservoirs in the basin have as primary authorized functions the control of floods and the storage and release of water for navigation, irrigation, and in some cases power generation. Nonstorage projects are for single-purpose navigation or flood control. Plan formulation studies for this report have shown that those projects, particularly the reservoirs, serve additional purposes incidental to operation for authorized primary uses. Further, by some minor operational modifications based on service, as a system, to all functions considered herein, increased efficiency and enlarged capability in some functional fields may be possible.

The potential additional functions to be considered for inclusion in a reauthorization of presently existing and authorized Corps projects are fish and wildlife enhancement, water supply, recreation, and water quality control. Each of those potential functions has been recognized by the Congress, since the projects were authorized, as appropriate for inclusion in plans for Federal water resource projects.

The existing and authorized projects, located as shown on Map II-2, and the potential for additional functions to be considered are discussed in the following paragraphs.

Detroit Dam and Reservoir Project

The Detroit Reservoir Project, including Big Cliff Reregulating Dam, now provides recreation, water quality, and fish life enhancement benefits. It has a potential use for municipal and industrial water supply, and the City of Salem has made request for a future supply. Fish life enhancement is based on improved streamflow, controlled temperature, and general water quality in North Santiam River. However, neither enhancement flows nor specific water temperatures are guaranteed

under the present authorization. Recreation potentials are being developed, principally by the State and Forest Service, but no guarantee of an operating plan based on recreation as one project purpose now exists. Municipal and industrial water supply requirements would be relatively small, and could be accommodated without apparent problems.

Green Peter, Foster, and Cascadia Dams and Reservoirs

Of these projects, Cascadia is authorized; the other two are existing. All projects are, or will be, used for recreation. Project operation, under existing authorization for navigation, provides increased low-water flows. At present, those flows are of good quality. However, temperature of water passing Foster is lower than desirable. Consideration should be given, in connection with reauthorization, to provision of temperature selection devices based on best subsystem operation of all three reservoirs. Water quality improvement and fish life enhancement potentials should be evaluated as project purposes, under alternative operating programs considering all uses of storage. Also, the potential for reservoir rearing of juvenile spring chinook salmon should be evaluated as a part of the enhancement potential. Any new municipal and industrial water supply requirements would be relatively small, and compatible with the other purposes to be considered.

Fall Creek Dam and Reservoir

Fall Creek Reservoir has been used successfully for rearing juvenile spring chinook salmon. However, present operating schedules and available facilities do not provide the optimum flow and temperature conditions for use of downstream spawning potentials. Those potentials, as well as recreation potentials, should be evaluated for Fall Creek as a part of the basin multiple-purpose storage system to serve presently authorized and possible new functions.

Lookout Point and Hills Creek Dams and Reservoirs

These projects, including the Dexter Reregulating Reservoir, provide recreational potential and some improvement of fish life habitat in Middle Fork Willamette River downstream from Dexter Dam. Both the recreation and fish life potentials, as well as the overall water quality control potential, are reduced by a turbidity problem which has existed since the major floods of December 1964. Studies should be made of that problem

and of the possibility that, in the future, physical and/or operational modification might be practicable to increase the present degree of fish life enhancement and water quality control. Municipal and industrial water supply uses apparently would be compatible with other authorized and potential new uses.

Dorena and Cottage Grove Dams and Reservoirs

These projects apparently have a fishery enhancement potential, and both are used for recreation in spite of an operating schedule calling for early drawdown each year. Cottage Grove appears suitable for reservoir rearing of juvenile spring chinook salmon. Dorena, if modified to include facilities for selection and release of water at the proper temperature, could improve downstream temperatures for spring and fall chinook salmon. Water quality improvement resulting from appropriate release schedules should be recognized by a reauthorization, as should recreational uses. Projected future demands for municipal and industrial water supply apparently would be compatible with other project uses.

Cougar, Blue River and Gate Creek Dams and Reservoirs

Cougar and Blue River are existing projects. Gate Creek is authorized as is the Cougar reregulating facility, Strube. Recreation is, and will continue to be, an important factor in McKenzie Subbasin; these projects could satisfy some of the increasing demand. Quantity and quality of streamflow are very good and there is little opportunity for fish life enhancement through modification of the flow regimen. There is considerable potential, however, in the proposed use of Gate Creek Reservoir for rearing anadromous fish. Also, although not necessary in McKenzie River itself, increased streamflows during low water periods would contribute to improved quality of Willamette River. Municipal and industrial water supply requirements probably could be satisfied with no adverse effects on other project purposes.

Holley Dam and Reservoir

The authorized Holley project provides for services only to the functions of flood control, navigation, and irrigation. Recent studies have resulted in a proposal for a modified Holley project to serve a wider range of needs. That modified project is included in the early action program and is discussed later in this section of the appendix.

Fern Ridge Dam and Reservoir

Fern Ridge is a major recreation attraction in upper Willamette Valley although it is authorized only for flood control, navigation, and irrigation. Improved water supplies and some operational changes as proposed in the early action program could permit continued intensive recreational activity. An improved reservoir fishery also could result waterfowl habitat would be improved, and additional municipal and industrial water supplies would be available.

Projects Studied by the Corps of Engineers

The Corps of Engineers took the lead in study of 13 of the early-action project elements of the overall plan. Included are: (1) four new multiple-purpose reservoirs; (2) physical modification to one existing multiple-purpose reservoir; (3) expansion and operational modification of one existing reservoir project; (4) two major tributary channel improvements; (5) a modified navigation channel project upstream from Willamette Falls; (6) a system of channel improvements as necessary for efficient flood control operation of major reservoirs; (7) channel stabilization at discontinuous locations on tributary streams; (8) additional recreation developments at existing and authorized reservoirs; and (9) enlargement of an authorized, but not yet constructed, multiple-purpose storage project.

All told, those elements would add more than 0.5 million acre-feet of storage, more than 9,000 acres of water area, and about 240 miles of channel works to totals now existing and assured. The total cost of the early-action elements would be in the order of $210 million. Annual operation and maintenance would cost about $3.2 million. Those costs include, for each project, the present worth of future recreation development.

The following paragraphs describe those projects.

Noon Dam and Reservoir

a. Location. - The Noon project would be at site No. 574, at river mile 17.5 on Marys River in Benton County. The dam site is located in Section 34, Township 11 South, Range 6 West of the Willamette Meridian. Map V-3 shows project location and approximate size.

b. Hydrology. - A dam at the Noon site would control runoff from an area of about 97 square miles, or 32 percent of the Marys River

drainage basin. Based on the 40-year period from 1926 through 1965, the maximum, minimum, and average annual runoffs of Marys River at the site are 381,000; 89,000; and 219,000 acre-feet, respectively. Maximum runoff occurred in 1956 and minimum in 1934. The minimum natural mean monthly flow at the Philomath gage, downstream from the dam site, is in the order of 17 cubic feet per second. In contrast, the maximum is in the order of 1,200 cubic feet per second. Consumptive withdrawals downstream from the dam site use substantially all flows during the summer.

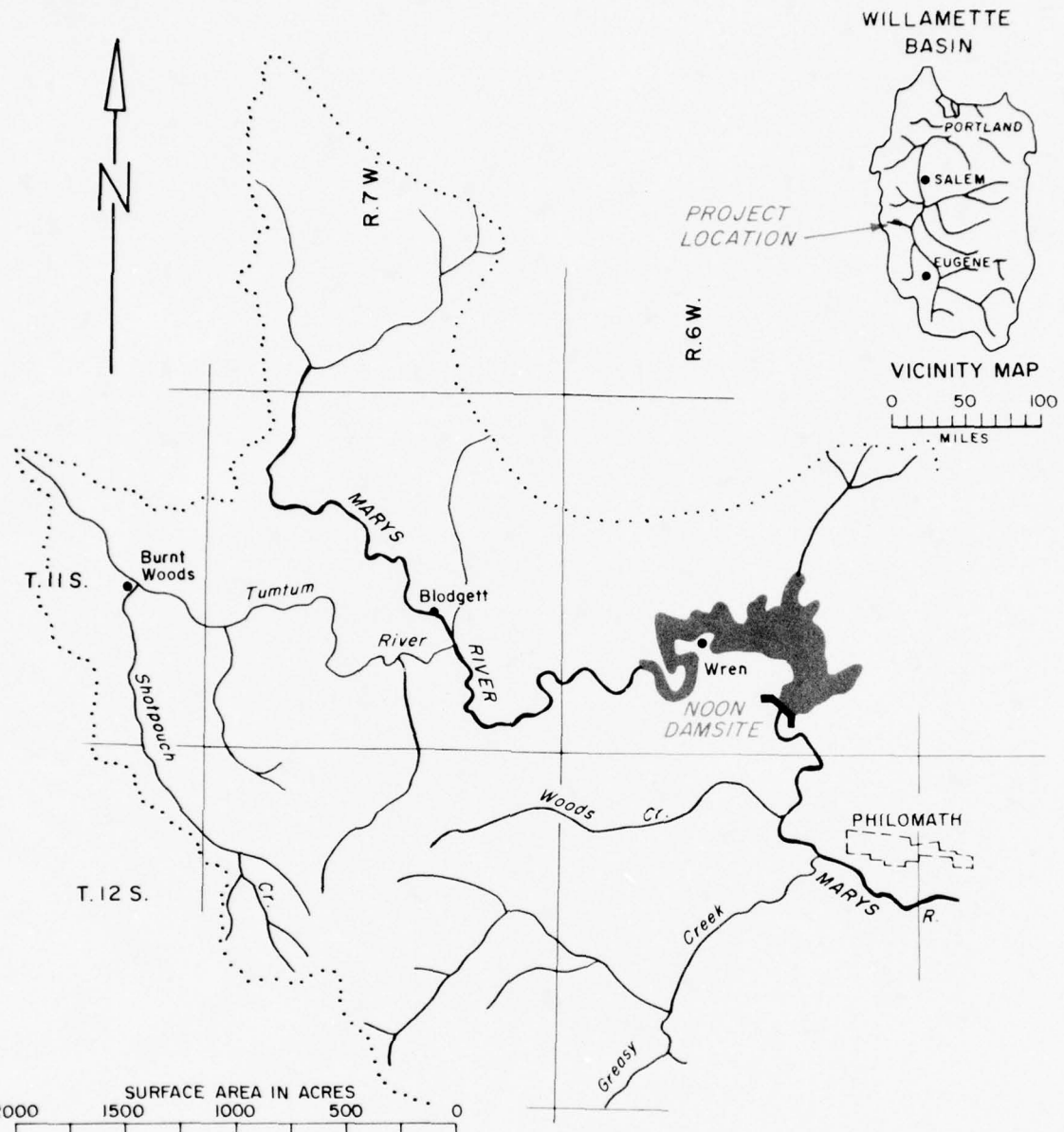
c. Project Description. - As now planned, Noon Dam would be a rockfill structure, with impervious core, rising about 202 feet above streambed. Length of dam would be about 1,900 feet at crest elevation 512 feet, m.s.l. Spillway and outlet facilities would be located on the left abutment. The dam would create a pool with maximum capacity of about 115,000 acre-feet and an area of about 1,725 acres at pool elevation 507 feet, m.s.l.

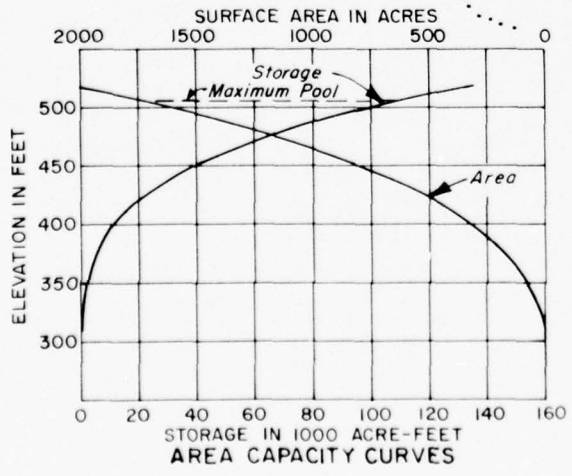
d. Reservoir area. - The area which would be inundated is principally in agricultural use. The unincorporated small community of Wren lies adjacent to the south side of the reservoir area. U. S. Highway 20, State Highway 223, county roads, and a branch rail line of the Southern Pacific Company traverse parts of the reservoir area, and would have to be relocated.

e. Project functions. - The project would be operated for flood control and to conserve water for irrigation, municipal and industrial water supply; and increased streamflows for use downstream for navigation and water quality improvement for recreation and fish life. Recreation facilities would be developed to permit use of the potential inherent in project lands and water area. Hydroelectric power generation would not be economically feasible. Except for a reservoir fishery, fish life and navigation uses would be limited to the effect of increased flows in Willamette River.

Use of about 78,000 acre-feet of the total storage space would provide at-site control of a 100-year flood. Resulting downstream flow and stage reductions would be:

Stream	Gaging Station	Reductions	
		Flow, Cfs	Stage, Feet
Marys River	Philomath	8,000	0.6
Willamette River	Albany	6,700	0.5
Willamette River	Salem	5,300	0.4





MAP V-3
WILLAMETTE BASIN STUDY
OREGON
NOON DAM & RESERVOIR
MARYS RIVER
1969
0 1 2 3
MILES

f. Economic analysis. - Total project cost would be in the order of $26.4 million. Annual charges based on an interest rate of 4-5/8 percent and a 100-year economic life, and including annual operation and maintenance, would be about $1.5 million. Evaluated average annual benefits would be about $1.5 million. On the basis of those costs and benefits, the project would have a benefit-to-cost ratio of about 1 to 1.

g. Environmental considerations. - Marys River is one of the streams listed for management under a program for preservation of unique and desirable natural environment. That listing, in Table V-16, shows an exception to permit construction of Noon Dam and Reservoir. That exception was made in consideration of the apparent overriding need for services, including improvement of downstream environment, for which no alternative means of satisfaction could be found. However, before any recommendation for Congressional authorization is made, full consideration and coverage of impacts on environmental resources and needs will be required. Such consideration and coverage would be consistent with the requirements of PL 91-190, the National Environmental Policy Act of 1969.

Pedee Dam and Reservoir

a. Location. - The Pedee project would be at site No. 302, at about river mile 30.3 on Luckiamute River in Benton and Polk Counties. The dam site is located in Section 33, Township 9 South, Range 6 West of the Willamette Meridian, about 800 feet downstream from the confluence of Pedee Creek and Luckiamute River. Map V-4 shows project location and approximate size.

b. Hydrology. - A dam at the Pedee site would control runoff from a drainage area of about 115 square miles, or 37 percent of the Luckiamute River drainage basin. Based on the 40-year period from 1926 through 1965, the maximum, minimum, and average annual runoffs at the dam site are 515,000; 171,000; and 335,000 acre-feet, respectively. Maximum runoff occurred in 1956 and minimum in 1941. The minimum natural mean monthly flow at the Pedee gage near the dam site is in the order of 25 cubic feet per second. In contrast, the maximum is in the order of 1,100 cubic feet per second. Consumptive withdrawals downstream from the dam site use most of the low-water-season flows.

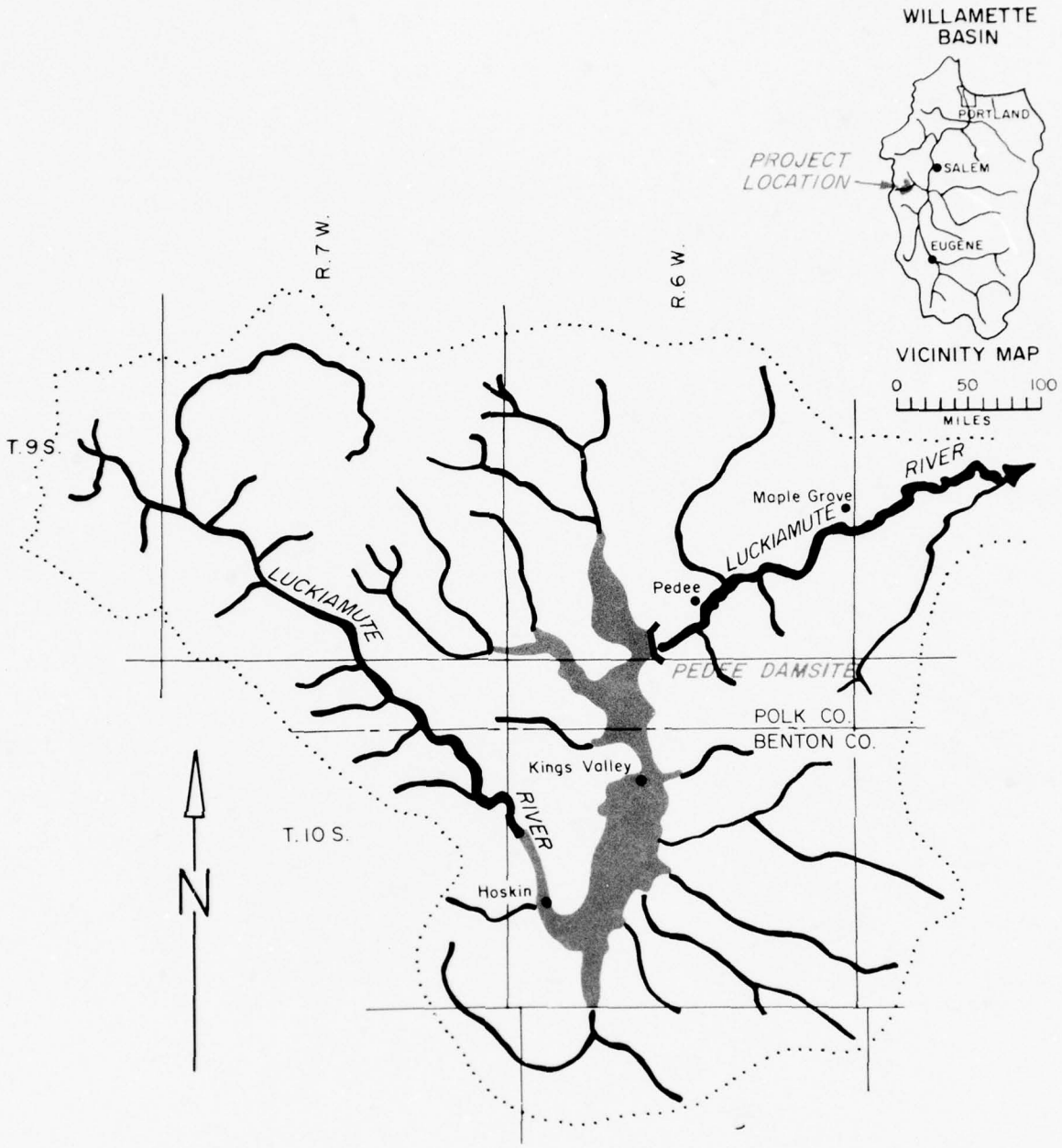
c. Project description. - Based on present plans, Pedee Dam could be either a rockfill structure, with impervious core, or a concrete gravity structure. It would rise about 118 feet above streambed and be about 550 feet long at crest elevation 368 feet, m.s.l. The spillway for an embankment dam would be located in a 225-foot-long saddle dam on the left abutment and the outlets would be in the right abutment. For a concrete gravity dam, both features would be incorporated in the basic structure. The dam would create a pool with maximum capacity of about 130,000 acre-feet and an area of about 3,700 acres at elevation 363 feet, m.s.l.

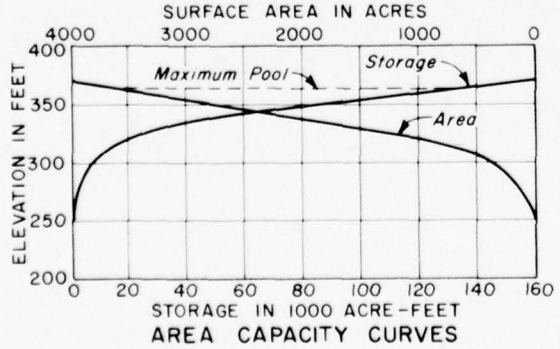
d. Reservoir area. - The area which would be inundated is used for agriculture and timber production and processing. It includes the unincorporated small community of Kings Valley. State Highway 223 traverses the length of the reservoir area, and connects to several county roads. The Valley and Siletz Railroad extends from head of reservoir downstream past the dam site. The roads and railroad would have to be relocated.

e. Project functions. - The project would be operated for flood control and to conserve water for irrigation, municipal and industrial water supply and increased downstream flows in the interest of navigation, and improved water quality for fish life enhancement and recreation. The reservoir could provide some waterfowl use and benefits. A reservoir fishery could be developed, and recreation facilities would be provided to permit use of the potential inherent in project lands and water area. Hydroelectric power generation would not be economically feasible. Navigation effects would be limited to Willamette River.

Use of about 93,000 acre-feet of the total storage space would provide at-site control of a 100-year flood. Resulting downstream flow and stage reductions would be:

Stream	Gaging Station	Reductions	
		Flow, Cfs	Stage, Feet
Luckiamute River	Suver	15,100	3.4
Willamette River	Salem	11,500	0.8





AREA CAPACITY CURVES

MAP V-4

WILLAMETTE BASIN STUDY
OREGON

PEDEE DAM & RESERVOIR
LUCKIAMUTE RIVER
1969

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MILES

f. Economic analysis. - Total project cost would be in the order of $29 million. Annual charges based on 4-5/8 percent interest and a 100-year economic life, and including annual operation and maintenance, would be about $1.7 million. Evaluated average annual benefits, would be in the order of $1.9 million. On the basis of those costs and benefits, the project would have a benefit-to-cost ratio of about 1.1 to 1.

Jordan Dam and Reservoir

a. Location. - The Jordan project would be at site No. 203, at about river mile 18.5 on Thomas Creek in Linn County. The dam site is located in Section 5, Township 10 South, Range 1 East of Willamette Meridian, about one-half mile downstream from the confluence of Jordan Creek and Thomas Creek. Map V-5 shows project location and approximate size.

b. Hydrology. - A dam at the Jordan site would control runoff from an area of 76 square miles, or 54 percent of the Thomas Creek drainage basin. Based on the 40-year period from 1926 through 1965, the maximum, minimum, and average annual runoffs are 477,000; 135,000; and 251,000 acre-feet, respectively. Maximum runoff occurred in 1958 and minimum in 1931. The minimum natural mean monthly flow at the gaging station near the dam site is in the order of 25 cubic feet per second. In contrast, the maximum is in the order of 670 cubic feet per second. Irrigation withdrawals use all available low-water flow downstream from the dam site in many years.

c. Project description. - Jordan Dam could be either a gravel or a rockfill structure with an impervious core. It would rise about 142 feet above streambed and be about 1,200 feet in length at crest elevation 632 feet, m.s.l. The spillway and outlet facilities would be located in the right abutment. The dam would create a pool with a maximum capacity of about 93,000 acre-feet and an area of about 1,880 acres at elevation 627 feet, m.s.l.

d. Reservoir area. - The area which would be inundated is used principally for agriculture. It includes the small unincorporated community of Jordan. A state highway and feeder routes traverse the reservoir area and would have to be relocated.

e. Project functions. - The project would be operated for flood control and to store water for irrigation and increased downstream flows in the interest of navigation and water quality for fish life and recreation. There would be a reservoir fishery, and recreation facilities would be provided to permit use of the potential inherent in project lands and water area. Hydroelectric power generation would not be economically feasible. Navigation uses would be limited to Willamette River.

Use of about 71,000 acre-feet of the available storage space would provide at-site control of a 100-year flood. Resulting downstream flow and stage reductions would be:

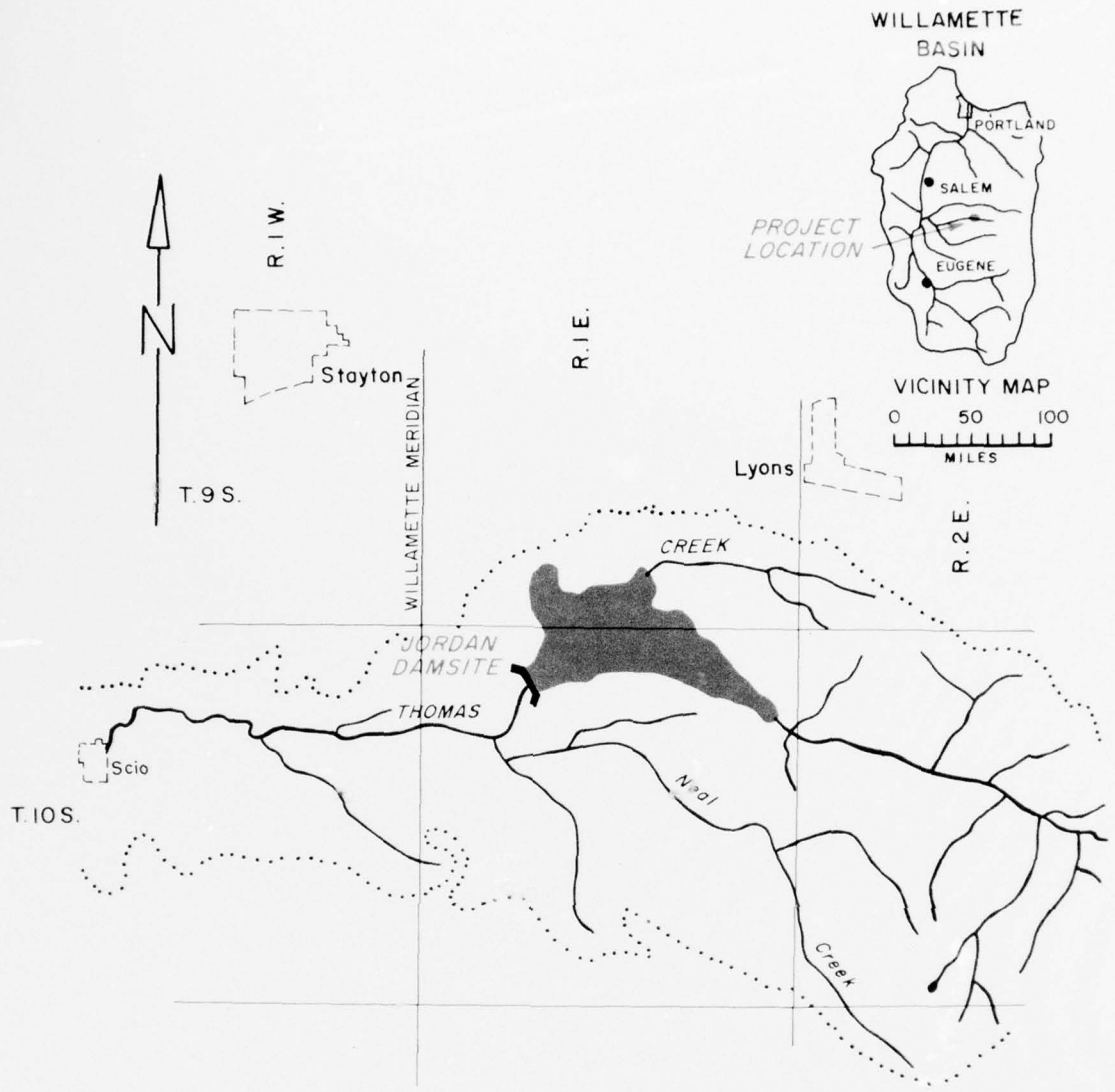
		Reductions	
Stream	Gaging Station	Flow, Cfs	Stage, Feet
Santiam River	Jefferson	12,900	0.6
Willamette River	Salem	10,600	0.8

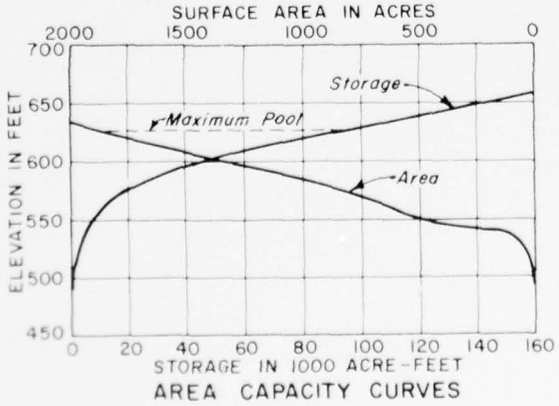
f. Economic analysis. - Total project cost would be in the order of $15 million. Annual charges based on 4-5/8 percent interest and a 100-year economic life, and including annual operation and maintenance cost, would be about $0.9 million. Evaluated average annual benefits would be about $1.7 million. On the basis of the foregoing costs and benefits, the project would have a benefit-to-cost ratio of about 2 to 1.

Lyons Dam and Reservoir

a. Location. - Lyons Dam would be at site No. 241, at about river mile 9 on Little North Santiam River in Marion County. The site is located in Section 8, Township 9 South, Range 3 East of the Willamette Meridian. Map V-6 shows project location and approximate size.

b. Hydrology. - A dam at the Lyons site would control runoff from an area of 91 square miles, or 83 percent of the Little North Santiam drainage basin. Based on the 40-year period from 1926 through 1965, the maximum, minimum, and average annual runoffs are 685,000; 282,000; and 467,000 acre-feet, respectively. Maximum runoff occurred in 1943 and minimum in 1931. The minimum natural mean monthly flow at the dam site is in the order of 45 cubic feet per second. In contrast, the maximum is in the order of 1,200 cubic feet per second. There are no irrigation or other significant consumptive withdrawals from Little North Santiam River.





AREA CAPACITY CURVES

MAP V-5

WILLAMETTE BASIN STUDY

OREGON

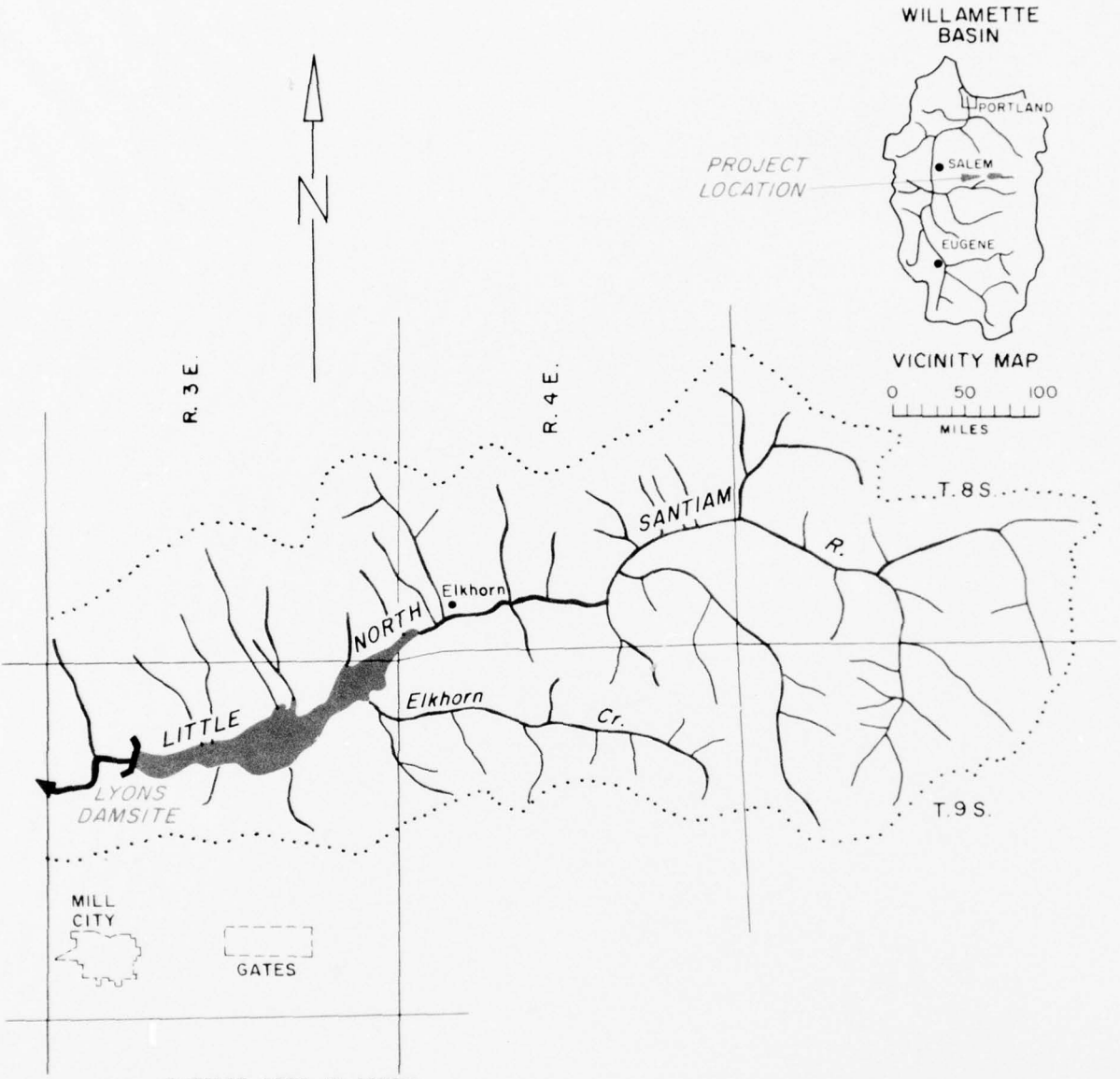
JORDAN DAM & RESERVOIR

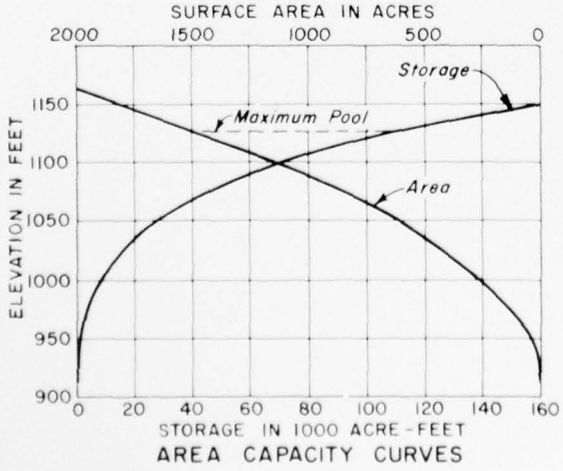
THOMAS CREEK

1969

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MILES





AREA CAPACITY CURVES

MAP V-6

WILLAMETTE BASIN STUDY

OREGON

LYONS DAM & RESERVOIR

LITTLE NORTH SANTIAM RIVER

1969

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MILES

c. Project description. - Lyons Dam could be either a gravel or rockfill structure with an impervious core. It would rise about 215 feet above streambed and be about 1,400 feet long at crest elevation 1,130 feet, m.s.l. Spillway and outlet facilities would be located in the left abutment. The dam would create a pool with maximum capacity of about 110,000 acre-feet and an area of about 1,500 acres at pool elevation 1,125 feet, m.s.l.

d. Reservoir area. - The reservoir area is being developed for rural and summer home sites. A main travelled road traverses the length of the reservoir area and would require relocation.

e. Project functions. - The project would be operated for flood control and to store water for municipal and industrial water supply and increased downstream flows in the interest of navigation and improved conditions for fish life and recreation. There would be a reservoir fishery, and facilities would be provided to permit use of the recreation potential inherent in project lands and water area. Hydroelectric power generation might be economically feasible. However, further study will be required to evaluate the interrelationship between operation for power and operation for other project purposes. Navigation uses would be limited to Willamette River.

Use of about 100,000 acre-feet of storage space would provide at-site control of a 100-year flood. Resulting downstream flow and stage reductions would be:

Stream	Gaging Station	Reductions	
		Flow, Cfs	Stage, Feet
N. Santiam River	Mehama	26,200	3.2
Santiam River	Jefferson	24,300	1.1
Willamette River	Salem	18,500	1.3

f. Economic analysis. - Total project cost would be in the order of $42 million. Annual charges based on 4-5/8 percent interest and a 100-year economic life, and including annual operation and maintenance cost, would be about $2.4 million. Evaluated annual benefits total about $2.5 million. On the basis of the foregoing costs and benefits, the project would have a benefit-to-cost ratio of about 1 to 1.

g. Environmental considerations. - Little North Santiam River is one of the streams listed for management under a program for preservation of unique and desirable natural environment. That listing, in Table V-16, shows an exception to permit construction of Lyons Dam and Reservoir. That exception was made in consideration of the apparent overriding need for services, including improvement of downstream environment, for which no alternative means of satisfaction could be found. However, before any recommendation for Congressional authorization is made, full consideration and coverage of impacts on environmental resources and needs will be required. Such consideration and coverage would be consistent with the requirements of PL 91-190, the National Environmental Policy Act of 1969.

Dorena Dam Modification

a. Location. - Dorena Dam is located at river mile 7.6 on Row River, a tributary of Coast Fork Willamette River.

b. Project Description. - Dorena Dam is an earth- and gravel-fill embankment 3,305 feet long at crest elevation 865.5 feet, m.s.l., and with a maximum height of 145 feet above the streambed. The concrete gravity free-flow spillway, near the right abutment, is 200 feet in length. Outlet works consist of five gate-controlled conduits passing through the spillway section. The reservoir has a usable storage capacity of 70,500 acre-feet and an area of 1,835 acres at full pool (spillway crest) elevation 835 feet, m.s.l. Authorized project purposes are flood control, irrigation, and navigation. Recreation facilities have been provided. The dam was placed in operation by the Corps of Engineers in 1949. Map V-1 shows project location.

Although reservoir drawdown for downstream needs normally begins before the midpoint of the recreation season, considerable recreation usage takes place at the reservoir's two recreational areas. An estimated 200,000 people now visit the project annually.

c. Proposed modification. - Study of flood control requirements for the 265-square-mile drainage area upstream from Dorena Reservoir indicates that an additional 82,500 acre-feet of flood control capacity would be required to control a 100-year flood at the site. Such a major expansion of storage at Dorena would not be physically or economically feasible. However, installation of a 5-foot-high control structure on

the crest of the 200-foot ungated spillway could provide ability to regulate use of up to about 10,000 acre-feet of additional storage space for flood control. Further consideration will be given to other possible uses, but raising the conservation pool level would interfere with present recreation developments and use.

d. Economic analysis. - Estimated cost of modification is about $800,000. Annual charges, based on an interest rate of 4-5/8 percent and a 100-year economic life and including operation and maintenance costs, would be about $44,000. The proposed modification would increase operational flexibility for flood control.

Evaluated annual benefits for flood control are estimated to be $56,000. The resulting benefit-to-cost ratio would be 1.3 to 1.

Fern Ridge Project, Modification for Recreation

a. Location. - Fern Ridge Dam is located at river mile 25.7 on Long Tom River in Lane County. Map V-1 shows location.

b. Project description. - The project includes Fern Ridge Dam and Reservoir and 25.7 miles of improved channel from the dam downstream to Willamette River. The dam creates a pool with maximum usable capacity of about 110,000 acre-feet at pool elevation 375.1 feet, m.s.l. The pool is raised to that level only for flood control. Normal pool (maximum conservation) level is 373.5 feet, m.s.l., at which elevation the pool has a usable capacity of about 95,000 acre-feet. Water-surface area at elevation 373.5, m.s.l., is about 9,000 acres.

c. Proposed modification. - No physical modification to existing structures is proposed. However, filling schedules should be reevaluated and the overall project should be modified by expansion as described below. The reevaluation should determine whether the indications now available as to improved filling capability without detriment to flood control are valid and whether modified operation should be initiated. Purpose of both modified operation and the expansion would be to maintain, and perhaps enhance, the recreation potential represented by the pool at the beginning of each summer season. Additional facilities involved would be those (1) for diversion from Willamette River; and (2) for additional storage upstream from Fern Ridge Reservoir.

As discussed in Part IV, several alternative means of diversion are available. Also, in the basin plan, there are two potential early-action small watershed reservoirs and a potential major long-range storage reservoir upstream from Fern Ridge. Local decisions are required regarding at least one of the diversion alternatives, would be involved in use of the small-watershed reservoirs, and might be involved in connection with the potential major storage site. In consideration of those factors, all of the projects are included in the plan subject to the results of additional study. Only one of the diversion alternatives is expected to be used.

Depending on the degree to which alternatives for additional water supply can be developed, there may be a need for removal of stumps from some additional part of the reservoir floor. Neither the necessity for such action nor the probable extent can be determined until decisions on alternative sources of water supply are available. Total removal, to a level safely below minimum pool elevation, would involve an area of about 40 acres.

d. Economic analysis. - A firm estimate of total costs cannot now be made because of the number of available alternatives and the fact that local decision will be required in the case of diversion, early-action storage and long-range storage alternatives. Based on information now available, however, that cost probably will be in the order of $2 million. Counting only the increment of Fern Ridge recreation benefits which could be preserved, an average annual benefit in the order of $1.4 million would be available. This is conservative, as it makes no allowance for possible enhancement due to assured annual filling.

With such an average annual benefit, a total expenditure in excess of $20 million could be justified. That amount would be ample to cover cost of diversion and a recreation share of the cost of upstream storage.

e. Local participation. - Local participation should be generally of the nature, and to the extent, provided for in PL 89-72. Based on present indications, it would appear that local accomplishment of any diversion and/or local construction of or participation in upstream storage as a replacement for Fern Ridge storage would be an integral

principal part of local participation. Decisions in regard to those alternative measures will be required before specific project recommendations are made.

Tualatin River Channel Project

The Tualatin channel project would be multiple-purpose, for flood control and recreation. It would include preservation of natural streamside environment to the maximum extent consistent with providing a justifiable measure of highly needed flood control and developing available recreation potential.

a. Location. - The work would extend along Tualatin River from the State Highway 224 bridge (Fields Bridge) at river mile 1.7, upstream to river mile 65 at a point near Gaston. Work also would be done on the lower reaches of East and West Fork Dairy Creek, and on Chicken, Rock, McKay, Beaverton, Gales, Scoggins, and Fanno Creeks, and Lousignont Canal. The existing Oregon Iron and Steel (OI&S) dam creates a low-water pool which extends upstream for about 30 miles and affects the lower reaches of streams tributary to the pool. Map V-7 shows project location and general information.

b. Hydrology. - Summer flows at the head of the OI&S pool often are reduced to zero by diversions for irrigation. Flood peak discharge frequencies, at that same point, are:

Frequency, years	Discharge, cfs
5	16,200
10	20,600
20	25,000
100	36,100

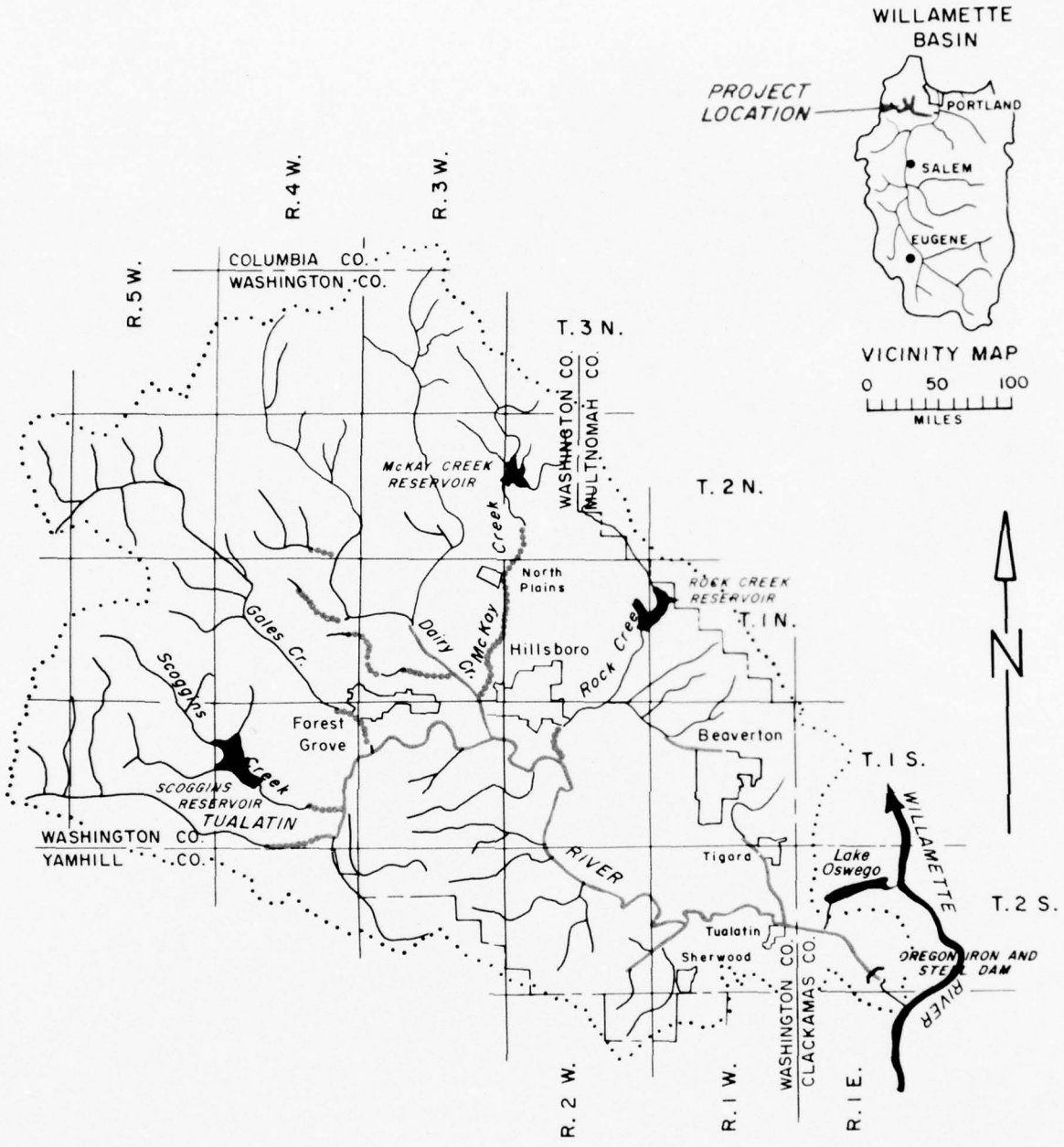
Operation of the authorized USBR Scoggins Dam, on Scoggins Creek near Gaston, and the McKay-Rock Creek dams in that watershed project will increase low-water flows and, together with waste treatment, provide greatly improved water quality. Those dams will have some effect in reducing flood peak discharges, but cannot provide a high degree of flood control until an improved channel for Tualatin River is provided. Channel improvement portions of the McKay-Rock Creek project also would be more effective if the Tualatin channel were improved.

c. Project Description. - The proposed project includes features for flood control, recreation lands and facilities, and environmental preservation. Those are described separately, in general terms and subject to development of more detail in subsequent planning, as follows:

(1) Flood control effects would be achieved by channel clearing excavation, and straightening, and reconstruction of the OI&S dam. Of those items, straightening, excavation, and dam reconstruction are by far the most significant. Straightening, by elimination of oxbow channel loops, would reduce the length of Tualatin channel within the project boundaries from about 63.3 miles to about 46.8 miles. Excavation would include channel widening and/or deepening. Widening would be limited to one bank only, at each location. Reconstruction of the dam would be to provide for full use of the enlarged channel section during floods and yet permit retention of the pool at all other times to satisfy existing adjudicated water rights. Clearing would be limited to the channel and those growths below top of bank which create significant obstructions to flow. The flood control channel would be designed for the maximum capacity justifiable under current criteria. Studies to date show that it might be improved to contain floods with a recurrence frequency of once in the order of 10 years, as regulated by upstream storage.

(2) Recreation features would consist of access roads, parking areas, boat-launching ramps, park and picnic facilities, and a system of hiking trails along appropriate channel reaches. In general, recreation development probably would be on lands severed from present ownership incidental to channel straightening for flood control. As subsequently discussed, however, some of those lands would be managed for environmental preservation. Access generally would be over construction roads, which would be laid out, in cooperation with a local sponsor, as a part of the plan.

(3) Preservation aspects of the project center on oxbow loops cut off for flood control, and on lands therein; on minimum disturbance by construction activities; and on restoration of suitable ground cover on cut slopes. Selected oxbows, particularly in the OI&S pool reach, would be preserved in the natural state. Access probably would be



LEGEND

Channel Rectification

Channel Clearing

MAP V-7

WILLAMETTE BASIN STUDY

OREGON

CHANNEL IMPROVEMENT

TUALATIN RIVER

1969

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MILES

limited to water and trail routes. Some oxbow reaches could be left completely free-flowing; others might be closed at the upstream end, except for culverts to provide for a flow at all times. Trail access to oxbow lands could be by bridge, or across fills in which culverts were incorporated.

In order to minimize the impact of construction work, access roads would be kept to one bank only, and channel widening would involve excavation of only one bank. As much as possible of the channel deepening would be done from floating equipment, to reduce the need for access roads. Spoil from straightening and enlarging would be deposited in selected locations away from the channel and recreation areas. Cut slopes would be blended with natural slopes, and landscaped with vegetation which could withstand inundation but not significantly impede flood flows.

d. Economic analysis. - Based on data now available, and subject to possible change upon completion of more detailed studies in coordination with a local sponsor, project cost would be in the order of $32 million. Annual charges would be about $2.4 million. With annual benefits in the order of $3.6 million, the benefit-to-cost ratio would be about 1.5 to 1.

No specific cost is shown for the environmental preservation aspect of the project. It is probable that acquisition specifically for that purpose would be limited; the rights-of-way and easements which would have to be acquired incidental to proposed work for flood control probably would satisfy the needs for preservation. Under those conditions, preservation costs probably would be limited to administrative costs plus limited development and maintenance costs for access facilities. Those costs can be held to a minimum by use of cooperatively planned construction access roads.

e. Local participation. - For the flood control aspects of the project, standard items of local cooperation spelled out in Section 3 of the 1936 Flood Control Act, as amended, would be required. Proposed participation in recreation and preservation aspects would be similar to that stipulated in Public Law 89-72 for reservoir projects; that is, payment of one-half of the separable cost and continuing administration,

maintenance, and operation of recreation and environmental features. It appears that oxbow lands acquired in lieu of severance, incidental to flood control work but not required for flood control purposes, could make up a considerable part of the local share in recreation and environmental costs.

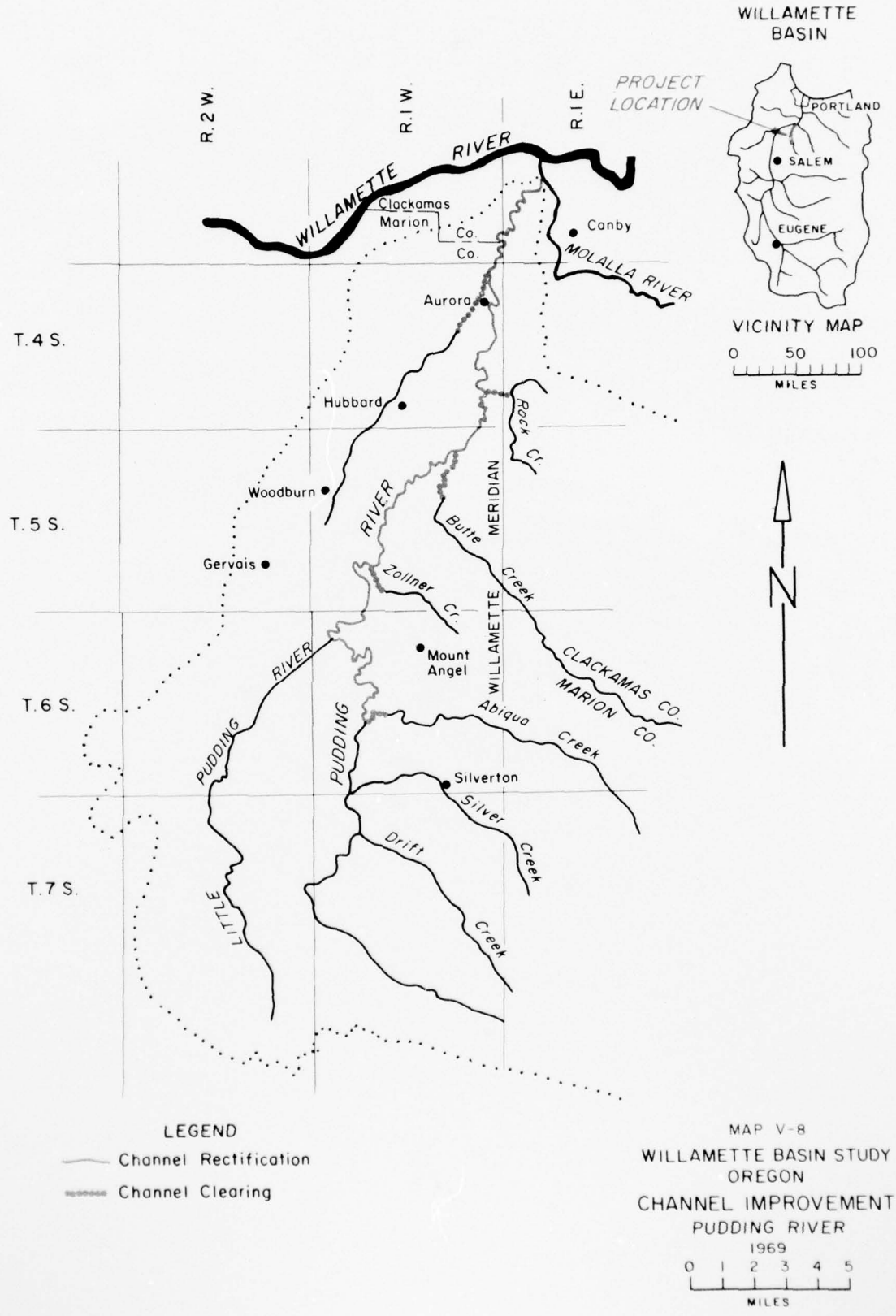
Pudding River Channel Project, Modification

a. Authorized project. - A flood control project for Pudding River was authorized by the Flood Control Act of 1941 and modified by the Flood Control Act of 1950, to include provisions for major drainage. No provisions for development and/or use of the recreation potential of the channel, or for any environmental preservation actions, were included. At present, the project is classified inactive.

The authorized project would provide a channel generally adequate to contain a flow ranging from about 9,000 cfs at river mile 45.7 to more than 15,000 cfs at the mouth. This would provide flood control benefits and a major outlet for drainage. The authorized work on Pudding River includes clearing, enlargement, and construction of cutoffs to reduce an existing channel length of about 46 miles to about 28 miles. Construction of a separate project, under PL 83-566, has eliminated the need for authorized work on Little Pudding River. Work on other tributaries (Abiqua, Zollner, Butte, Rock, and Mill Creeks) would be limited to clearing and snagging. Map V-8 shows project location.

b. Proposed modification. - The proposed modifications are those which would make the project responsive to needs not recognized 20 years ago. Those modifications would be compatible with, and to a degree dependent on, the State's program of at-source waste treatment and the early-action proposal for flow augmentation by storage. The specific items involved would be provisions for development and use of recreation potentials, and provision for safeguarding desirable natural environment.

Such provisions would be generally comparable to those already discussed for the proposed Tualatin channel improvement project, but with differences in detail. The differences reflect basic differences between Tualatin and Pudding Rivers.


WILLAMETTE BASIN
PROJECT LOCATION
PORTLAND
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EUGENE
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MILES
R.2 W.
R.1 W.
R.1 E.
WILLAMETTE RIVER
Clackamas Co.
Marion Co.
Canby
MOLALLA RIVER
Aurora
T.4 S.
Hubbard
Rock Cr.
Woodburn
T.5 S.
RIVER
Butte Creek
MERIDIAN
Gervais
Zollner Cr.
WILLAMETTE
Mount Angel
CLACKAMAS CO.
MARION CO.
T.6 S.
PUDDING RIVER
PUDDING
Abiqua Creek
Silverton
Silver Creek
Drift Creek
T.7 S.
LITTLE
N
LEGEND
Channel Rectification
Channel Clearing
MAP V-8
WILLAMETTE BASIN STUDY
OREGON
CHANNEL IMPROVEMENT
PUDDING RIVER
1969
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MILES

Both streams flow through wide flood plains in meandering, tortuous channels only shallowly entrenched below general ground level. Stream slopes are such that flow is sluggish; as a consequence, winter floods cause frequent overflow and prolonged ponding. Summer flows drop to levels inadequate to sustain resident populations of cold-water game fish. Pudding River, however, is freeflowing throughout its length, except for constrictions formed by shoals and drift jams. Channel improvements for flood control would remove those constrictions, make the stream completely freeflowing, and drain most of the oxbows.

Under those conditions, and with augmented low-water flows in the order of only about 40 cubic feet per second, water-based recreation use could not be expected to include boating and water skiing. Neither would it be practical to maintain water surface area and flow in bypassed oxbow bends, without provision of low-water flow barriers which could be removed during the flood season.

In view of potentials so limited, the recreation plan provides for only a limited development during the early-action period, with additional potential for use as needs may warrant. Land-based development during the early-action period probably would be confined to one or two selected areas severed from present ownership incidental to channel straightening for flood control. Access to such areas would be over construction roads laid out for that purpose as a part of the plan. Low-water barriers to create recreation pools, and relate additional recreation development, would be a long-range possibility to be given further study before agency recommendations are made.

Pudding River should be considered by the State, and by Clackamas County, as an opportunity to implement program recommendations for green space, open space, and parkway. Preservation aspects of the early-action Pudding River plan, however, are limited to minimum disturbance of ground cover during construction, and restoration of ground cover on cut slopes. Selected oxbow loops and/or severed land areas could be preserved in a natural state; this would be done to an extent consistent with the type and extent of resource involved, the ability to preserve flow in the loops, and the availability of public access. Access roads for construction and maintenance would be kept to one bank, as would

excavation required for channel widening. Excavated material would be placed in selected areas compatible with the recreation and preservation aspects.

c. Economic analysis. - Estimated costs would be in the order of $8.8 million, including the value of lands, easements, and rights-of-way. Annual charges would be about $0.6 million. Average annual benefits would be about $0.8 million. The resulting benefit-to-cost ratio would be about 1.4 to 1.

d. Local participation. - For the flood control aspects of the project, standard items of local cooperation spelled out in Section 3 of the 1936 Flood Control Act, as amended, would be required. Proposed local participation in recreation and preservation aspects would be similar to that stipulated in Public Law 89-72 for reservoir projects; that is, payment of one-half of the separable cost and continuing administration, maintenance, and operation of recreation and environmental features. It appears that oxbow lands acquired in lieu of severance, incidental to flood control work but not required for flood control purposes, could make up a considerable part of the local share in recreation and environmental costs.

Basin-System Channel Improvement

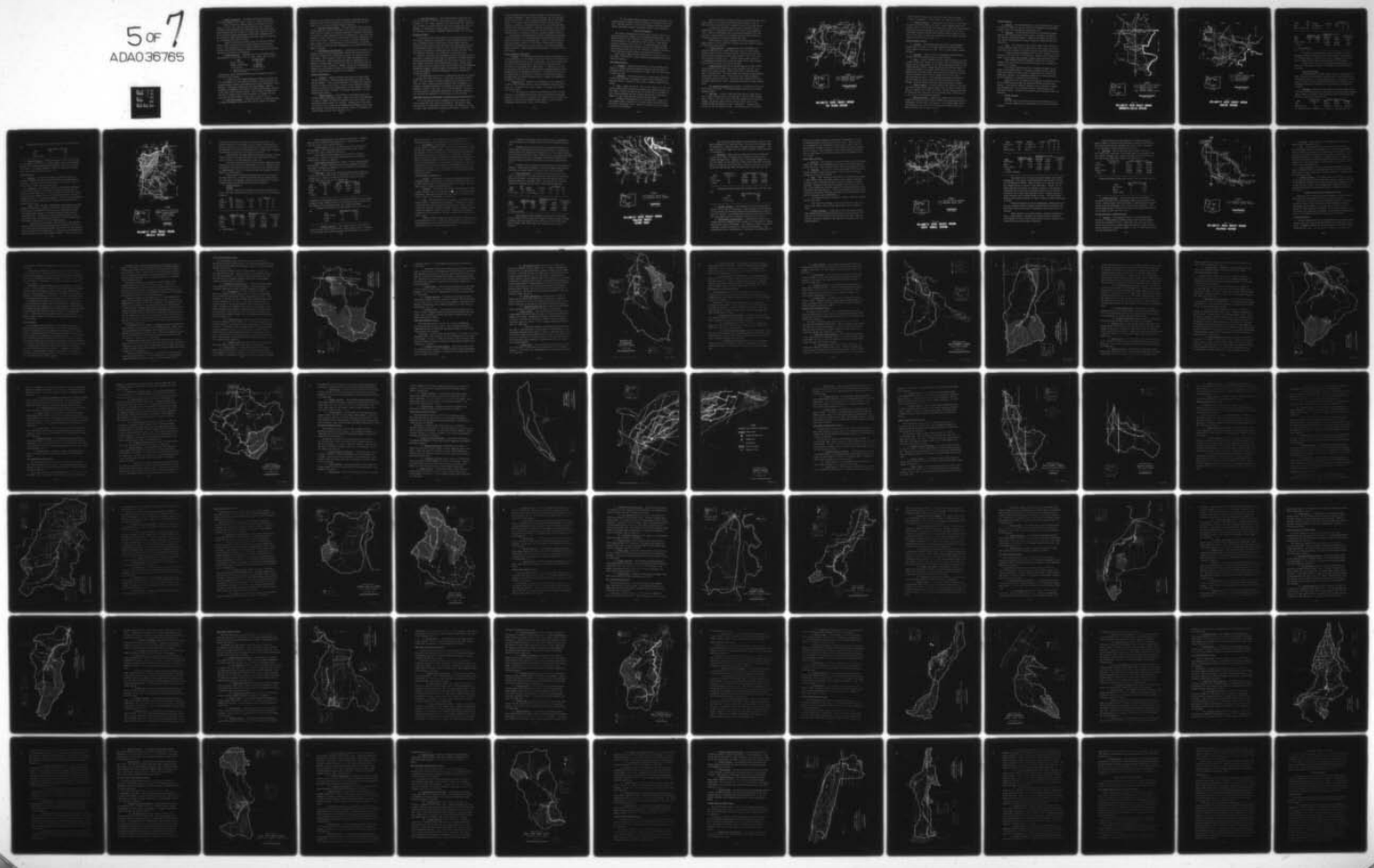
Basin-system channel improvement, as discussed in Part IV, would be done to facilitate flood control operation of storage.

a. Location. - Work would be done on Willamette River and each major reservoir-controlled tributary except Pudding and Tualatin Rivers. Separate projects for those streams are discussed in preceding text. Also, some further improvement of the downstream end of the existing Long Tom channel may be required. No map coverage is provided to show details of location. It is recognized that, because of the unstable nature of the channel reaches involved, new problem areas may develop before specific agency recommendations can be made. Also, channel changes may eliminate some of the present problem areas from consideration by that time. The total magnitude of work required, however, is expected to remain about as at present.

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THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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ADA036765



b. Project description. - The works involved include closure of overflow channels, and a general program of channel stabilization.

About 2.6 miles of channel closures are proposed for early action. Of that total, about 0.5 mile would be at one location on Willamette River downstream from Salem, about 0.8 mile at four locations between Salem and the mouth of Santiam River, and about 0.9 mile at two locations between Harrisburg and the mouth of McKenzie River. Two closures on Middle Fork Willamette would total about 0.2 mile, and five on McKenzie River about 0.2 mile.

Channel stabilization works at about 138 locations totaling about 44 miles in length would be required during the early-action period. Minor modification to the Long Tom channel may prove to be justified, but detailed hydraulic studies will be necessary to determine the nature and extent of work required.

c. Economic analysis. - Estimated cost of basin-system channel improvements is in the order of $11.2 million, broken down as follows:

Item	Estimated Costs
Channel closures	$ 800,000
Channel stabilization	10,400,000
Total project	$11,200,000 1/

1/ *Exclusive of possible minor work on Long Tom channel.*

Average annual costs, including operation and maintenance, would be in the order of $0.7 million.

In addition to facilitating reservoir operation for flood control and enhancing the flood control efficiency of those projects, the proposed system of channel improvements would provide significant at-site benefits. Preliminary studies show that those benefits, based on prevention of inundation, land loss, and channel deterioration, would be in the order of $0.9 million annually. Thus, without consideration of the value of enhanced flood control efficiency of storage, the work would have an overall benefit-to-cost ratio of about 1.2 to 1.

d. Local participation. - Because the need for a basin-wide system of channel improvement stems from flood control operation of Federal

reservoirs, the proposed work would be Federally constructed and maintained, similar to the existing Long Tom channel downstream from Fern Ridge Dam. No local participation would be required.

e. Fish and wildlife effects. - The work involved would be discontinuous, generally limited to one bank of the stream at any location, and almost totally confined to areas which presently are unstable and subject to significant annual change by erosion or overbank flow. Thus little and perhaps no overall adverse effect on fish and wildlife is anticipated for work at any location. However, in the course of necessary additional agency studies prior to recommendation for authorization, consideration will be given to minimizing and compensating for any adverse effect which might be foreseen.

f. Environmental considerations. - Willamette River and some of the tributary streams on which basin-system channel work would be done are listed for management for preservation of unique and desirable natural environment. That listing, in Table V-16, shows exceptions for the basin-system work. Those exceptions were made in consideration of an apparent overriding need for services for which no alternative means of satisfaction could be developed. However, before any recommendation for Congressional authorization is made, full consideration and coverage of impacts on environmental resources will be required.

Channel Stabilization

a. Location. - Unstable channels which shift in location cause channel deterioration, increased inundation damage, and loss of lands and improvements. A few such problems exist on streams where reservoir control of flows is not a factor. Because of the constantly changing location and extent of such problem areas, no map coverage is provided. Locations will have to be shown, to the extent practicable, in a subsequent agency report.

b. Proposed project. - The solution to the problem would be to provide channel stabilization works. About 14 locations, totaling about 4.6 miles in length, on Sandy and Clackamas Rivers and possibly a few locations on other streams, are involved. Estimated cost of the work is in the order of $1 million, and average annual charges would be about $60 thousand. With average annual benefits of about $70 thousand, the overall benefit-to-cost ratio would be 1.2 to 1.

c. Local participation. - Local participation would be that required by Section 3 of the 1936 Flood Control Act, as amended; that is, provision of: (1) lands, easements, and rights-of-way; (2) assurances that the Federal Government would be held free and saved from claims of damages; (3) assurances of project operation and maintenance; and (4) necessary alterations of highways, highway bridges, and utilities.

Navigation Channel

The proposed physical modification to the existing overall navigation project consists of construction of the authorized new single-lift lock at Willamette Falls and provision of depths greater than now authorized from Willamette Falls upstream to the Albany-Corvallis reach. Increased depths would be attained by open-river improvements similar to those now authorized, in combination with increased low-water flows from existing, authorized, and proposed new storage reservoirs.

Plans for construction and maintenance of open-river works would be developed in coordination with plans for operation of storage reservoirs, for basin-system channel improvement for flood control and for future fall chinook production in the Salem-Corvallis reach. Channel extent and location, and spoil disposal from initial construction and subsequent maintenance dredging, would be planned to minimize any adverse effect on fish and wildlife, recreation development and use, and desirable natural environment.

As discussed above and in Part IV, additional study will be required to evaluate the extent and cost of a justifiable increment of channel depth. For that reason, no project dimensions and no benefit-to-cost ratio are shown. However, potential benefits shown in Appendix I, for movement of tonnage projected to be available and suitable for water transport, would be in the order of $1.5 million annually. Those benefits would justify a substantial expenditure for channel improvement, over and above the approximate $13.6-million cost of a new lock.

Additional Recreation Development at Existing and Authorized Reservoirs

All of the existing Corps of Engineers reservoir projects have been provided with some recreation development. Included are lands, and facilities for picnicking, camping, boating, and swimming, as well as access roads, parking areas, and water and sanitary facilities. Some

of the existing facilities have been provided, at Federal expense, by the Corps of Engineers. Some of those provided by the Corps are maintained by Lane County. Others have been provided, and are maintained, by the U. S. Forest Service, the State of Oregon, and Lane and Linn Counties. Similarly, recreation facilities will be provided and maintained at the authorized projects. (All such development, both initial and long-range, for the Holley Reservoir has been included in the cost estimates shown in a separate report on a proposed modified project.)

The additional development which would be accomplished, during the early-action period, at the existing and authorized projects would be similar in nature to that described above. Costs, not identified with individual projects, would be in the order of $14 million, including additional land acquisition at some projects. Cost-sharing decisions remain to be made. Annual operation and maintenance cost would be about $0.8 million.

Holley Reservoir Modification

a. General. - The 1950 Flood Control Act provides authorization for a dam and reservoir at the Holley site at river mile 45.5 on Calapooia River. The authorized project has not been constructed. It would provide 97,000 acre-feet of total storage space, to be used for flood control and to store water for navigation and irrigation use. In connection with this overall basin study and under a 1959 review study authorization the Corps of Engineers has recommended authorization of a modified Holley project. The modification so recommended is listed as an early-action element of the basin plan; the overall modified project is needed and economically justifiable at this time.

b. Modified Plan. - Details of the modified plan are contained in a report by the Portland District, Corps of Engineers, entitled Interim Report No. 1, Calapooia River Basin, Oregon. In summary, the modified plan would include:

(1) An increase in capacity, from 97,000 acre-feet to 145,000 acre-feet. The enlarged project would serve the originally authorized purposes of flood control, irrigation, and navigation, plus the additional purposes of municipal and industrial water supply, fish and wildlife enhancement, water quality control, and recreation.

(2) The minimum channel improvement required downstream along Calapooia River to permit efficient operation of storage for flood control. That work would be in lieu of two separate, and more extensive, channel improvement projects authorized in 1950 but not constructed.

Bureau of Reclamation

The Bureau of Reclamation took the lead in study of seven of the early-action project elements of the comprehensive basin plan. Those elements consist of six divisions of the Willamette River Project plus the second phase of the authorized Tualatin Project. Those overall features include for early action (1) 11 multiple-purpose storage reservoirs to provide about 843,000 acre-feet of storage space and 14,495 acres of water area, and (2) diversion, conveyance, and distribution facilities to serve lands in the irrigation projects.

Total cost of USBR early-action elements of the plan would be in the order of $495 million. Annual operation and maintenance would cost about $3.6 million.

Red Prairie Division

a. Location. - The Red Prairie Division of the Willamette River Project is located in Polk and Yamhill Counties on the west side of Willamette Valley, about 20 miles west of Salem. Map V-9 shows project location and size.

b. Functions. - The Division would be a multipurpose development to serve the functions of irrigation, flood control, recreation, and fish and wildlife, including a water supply to Baskett Slough Wildlife Refuge.

c. Plan. - Gorge dam site No. 281, at river mile 11.2 on Mill Creek, would be constructed and operated to enhance the anadromous fishery of Mill Creek; to supply irrigation water to 15,500 acres of irrigable dry land; create recreation and lake fishing opportunities; and provide a measure of flood control during the nonirrigation season.

Irrigation requirements would be released into a canal on the left abutment which, together with a lateral system, would distribute the water to the project lands. Drainage facilities are also included in the plan of development.

Reservoir operation to insure filling for conservation uses would permit control of all anticipated floods before December, of 50- to 100-year floods in December, and of smaller floods in and after January.

A significant reservoir fishery would be created as well as enhancement of the anadromous fishery in Mill Creek through augmented flows. Wildlife enhancement would be effected by providing some 1,500 acre-feet of water annually to the Baskett Slough Wildlife Refuge for maintaining ponds and irrigating wildlife feed crops.

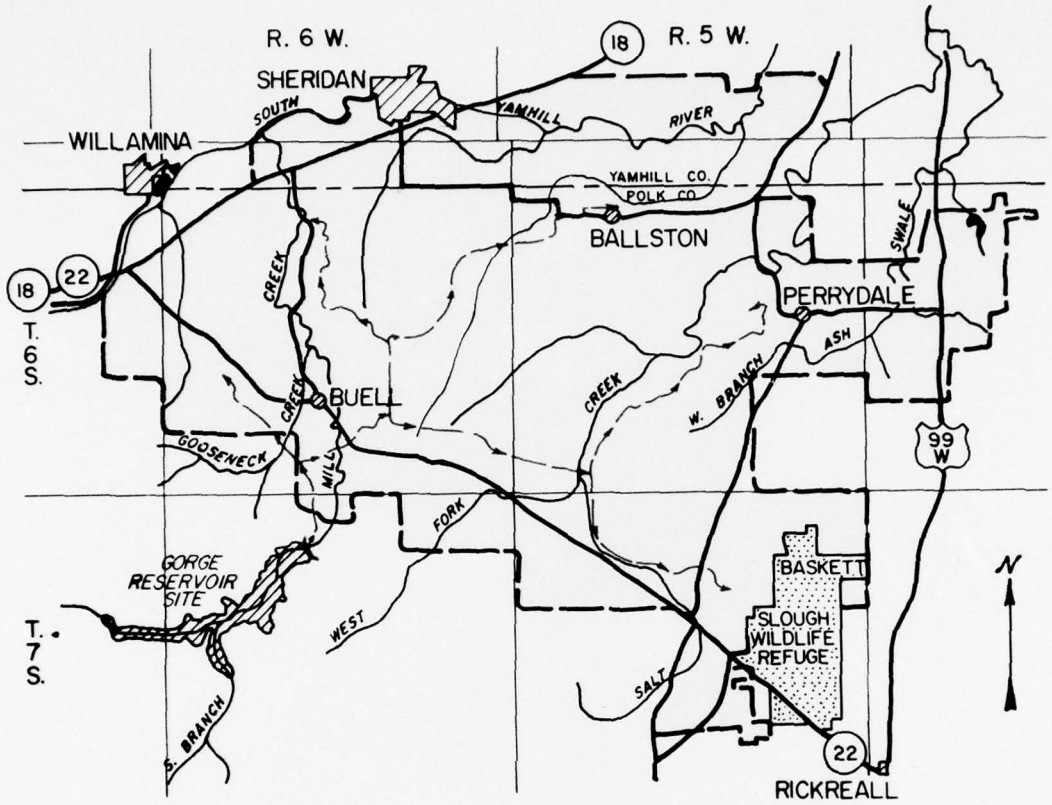
Gorge Reservoir would be operated to provide desirable water-based recreation, and is expected to quickly reach its capacity of about 67,000 visitor-days annually.

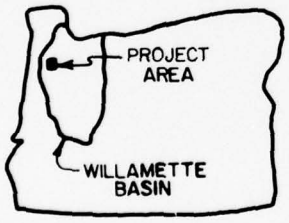
d. Project Features. - Gorge Dam would be an embankment-type structure comprised of a central impervious section of rolled earth flanked on the two faces by rockfill shells. The dam would rise about 270 feet above streambed and would have a length of about 1,640 feet at crest elevation 761 feet, m.s.l. Spillway features would consist of an unregulated "morning glory" intake and tunnel in the right abutment. Outlet facilities would be in the left abutment.

Gorge Reservoir would have a maximum capacity of about 53,000 acre-feet and an area of 560 acres at pool elevation 748 feet, m.s.l. Lands to be acquired consist of 669 acres of public lands and 1,553 acres of private lands. The private lands are essentially noncultivated, covered with timber or brush. There is one set of farm buildings in the reservoir area at this time. The public lands consist of 38 acres of public domain and 631 acres of Oregon and California Railroad revested lands.

The distribution system would consist of 30 miles of main canals, and 60 miles of laterals. The drainage system would be about 16 miles aggregate length.

e. Hydrology. - A dam at Gorge site would control runoff from an area of about 31 square miles, or 54 percent of the Mill Creek drainage basin. Based on the 41-year period from 1925 through 1965, the maximum, minimum, and average annual runoffs of Mill Creek at the site are 158,000; 58,000 and 106,000 acre-feet, respectively. Maximum runoff occurred in 1927 and minimum in 1941. The minimum natural mean monthly





KEY MAP

LEGEND

IRRIGATION DISTRICT BOUNDARY

IRRIGATION SERVICE AREA

PROPOSED CANALS

0 1 2 3 4

SCALE IN MILES

MAP V-9

WILLAMETTE RIVER PROJECT OREGON
RED PRAIRIE DIVISION

flow at the dam site is in the order of 2 cubic feet per second. In contrast, the maximum is in the order of 911 cubic feet per second.

f. Economic Analysis. - Total project cost would be in the order of $31 million, based on 1967 price levels. Annual charges based on an interest rate of 4-5/8 percent and a 100-year economic life, and including annual operation and maintenance cost, would be about $1.6 million. Preliminary evaluated average annual benefits would be about $1.6 million. On the basis of those costs and benefits, the project would have a benefit-to-cost ratio of about 1 to 1.

Monmouth-Dallas Division

a. Location. - The Monmouth-Dallas Division of the Willamette River Project is located in the middle subarea in southeastern Polk County, about 10 miles west of Salem. Map V-10 shows project location and size.

b. Functions. - Under the plan of development, Monmouth-Dallas Division would be a single-purpose irrigation project.

c. Plan. - Initial irrigation service would be supplied to an area of about 17,200 acres through use of natural flows from Willamette River. Annual diversion requirements for the initial development would be about 57,000 acre-feet; however, design and construction would be based on ultimate enlargement to use about 87,000 acre-feet to serve a total of 28,000 acres. The water supply, which would be available from natural flows of Willamette River, would be pumped from the river into a canal distribution system. Participating water users would pump from the main canal and lateral system into their individual sprinkler systems. Division drainage facilities would be provided as needed.

d. Project Features. - Project features would include a main pumping plant, several relift pumping plants, about 34 miles of canals, 60 miles of laterals, and 76 miles of drains. The main pumping plant would be located at about river mile 107 on Willamette River, in Section 26, T. 9S., R.4W. of the Willamette Meridian.

e. Economic Analysis. - Capital cost would be about $24 million. Annual cost, based on 4-5/8 percent interest and including operation and maintenance, would be about $1.4 million. With average annual irrigation benefits in the order of $2.2 million, the project would have a benefit-to-cost ratio of about 1.6 to 1.

Carlton Division

a. Location. - The Carlton Division of the Willamette River Project is located in Yamhill County near the City of McMinnville in the middle subarea. Map V-11 shows project location and size.

b. Functions. - Carlton Division would be a multipurpose development to serve the functions of flood control, irrigation, recreation, and fish and wildlife enhancement. Municipal and industrial water supply could be incorporated as a project function if needs and users are identified.

c. Plan. - Two reservoirs, Pike on North Yamhill River and Moores Valley on Haskins Creek, would be operated for flood control and to conserve water for irrigation, recreation, and fish and wildlife enhancement.

Irrigation water requirements would be met by releases from both reservoirs into the river at the Pike site. Pumping plants would deliver water to about 30,000 acres through a pressure-pipe distribution system.

Pike Reservoir would be operated to control up to 100-year floods at the site; Moores Valley would have flood control effects only incidental to filling.

The project operation would meet recommended minimum fishery flows in North Yamhill River. Irrigation releases into North Yamhill River would improve the fish habitat to enhance both the resident and anadromous fisheries. The designated minimum pools in both reservoirs would be beneficial to reservoir fish production.

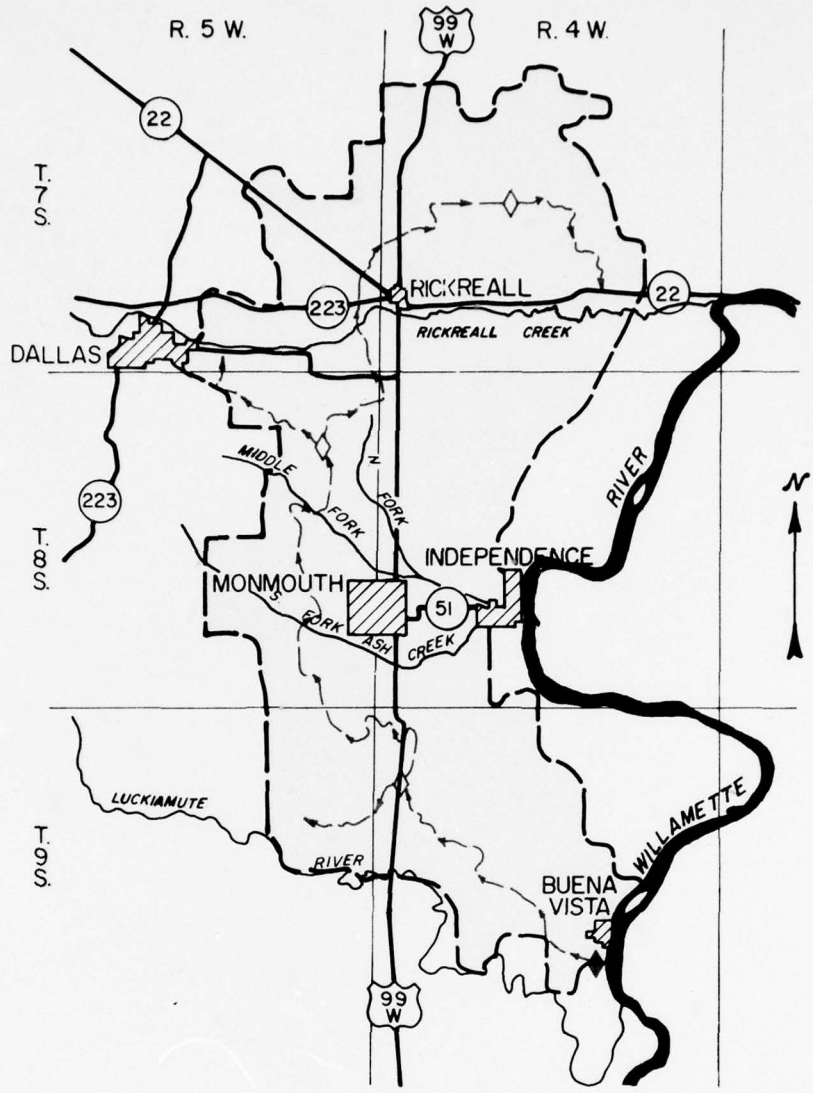
Operation of the two reservoirs is expected to support an initial use of 149,000 recreation-days and ultimately 800,000 recreation-days annually. Moores Valley reservoir probably would be operated to remain full throughout most of the recreation season, creating substantial recreation benefits. Recreation facilities would be provided around both reservoirs.

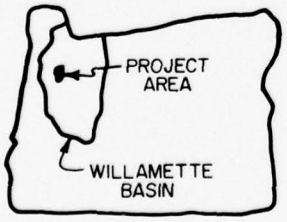
d. Project Features. -

Storage

Both dams would be earthfill structures with impervious cores.

Location, dimensions, and capacities are shown in the following summaries:





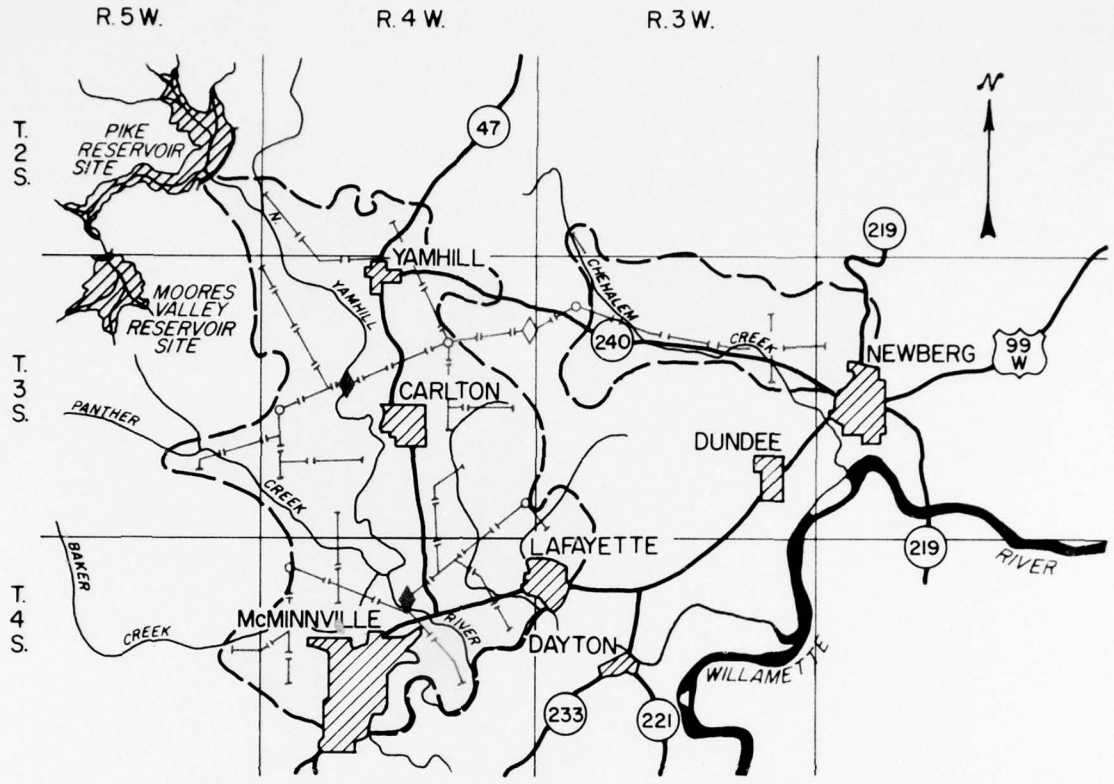
LEGEND

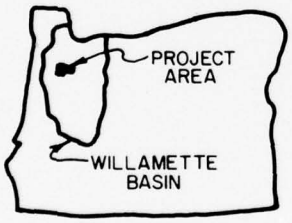
- IRRIGATION DISTRICT BOUNDARY
- IRRIGATION SERVICE AREA
- PROPOSED CANALS
- PROPOSED PUMPING PLANTS

0 1 2 3 4 5
SCALE IN MILES

MAP V-10

WILLAMETTE RIVER PROJECT OREGON
MONMOUTH-DALLAS DIVISION





KEY MAP

LEGEND

- IRRIGATION SERVICE LANDS
- PROJECT BOUNDARY
- PIPE DISTRIBUTION
- PUMPING PLANTS

0 1 2 3 4 5

SCALE IN MILES

MAP V-11

WILLAMETTE RIVER PROJECT OREGON
CARLTON DIVISION

Site	Site No.	Stream	R. Mile	Location Sec.	T.	R.
Pike	306	N. Yamhill R.	20.4	25,26	2S	5W
Moores Valley	292	Haskins Cr.	1	4	3S	5W

Name	Dimensions, feet Height 1/	Length	Storage Cap., ac.-ft. Dead and Inactive	Total	Surface Area, acres
Pike	157	2,900	10,000	75,000	1,200
Moores Valley	137	740	8,000	30,000	700
Totals			18,000	105,000	1,900

1/ Above streambed

Pike Reservoir would inundate the small community of Pike, a substantial amount of agricultural land, and possibly a small amount of Mt. Pleasant Cemetery. Several county roads, a logging road, and the City of Yamhill's water supply line would have to be relocated.

Moores Valley Reservoir would inundate primarily arable land with only a few homes in the area. Two county roads would have to be relocated.

Distribution System

Two pumping plants on North Yamhill River, in conjunction with about 130 miles of pipeline, would provide water to about 30,000 acres at sprinkler pressure. A booster pumping station, located about 4 miles east of the town of Yamhill, would deliver water into Chehalem Valley. Drainage facilities are included in the plan and would be constructed as needed.

e. Hydrology. - Dams at the two sites would control runoff from a total area of 66 square miles, or 36 percent of the North Yamhill drainage basin. Based on records for the 41-year period from 1928 through 1968, the water yields at the dam sites are:

Site	Drainage Area, sq. mi.	Annual Runoff, ac.-ft. Max.	Min.	Average
Pike	66	266,000	82,000	163,000
Moores Valley	15 1/	56,200 1/	18,300 1/	38,000 1/

1/ Haskins Creek is tributary to N. Yamhill R. upstream from Pike.

Minimum and maximum natural mean monthly flows at the dam sites are:

Site	Mean Monthly Flow, cfs	
	Min.	Max.
Pike	3	1,380
Moores Valley	0	283

f. Economic analysis. - Total capital cost for the Division would be in the order of $57 million. Annual charges, based on 4-5/8 percent interest and including operation and maintenance cost, would be about $3.4 million. With annual benefits of about $3.4 million, the project would have a benefit-to-cost ratio of 1 to 1.

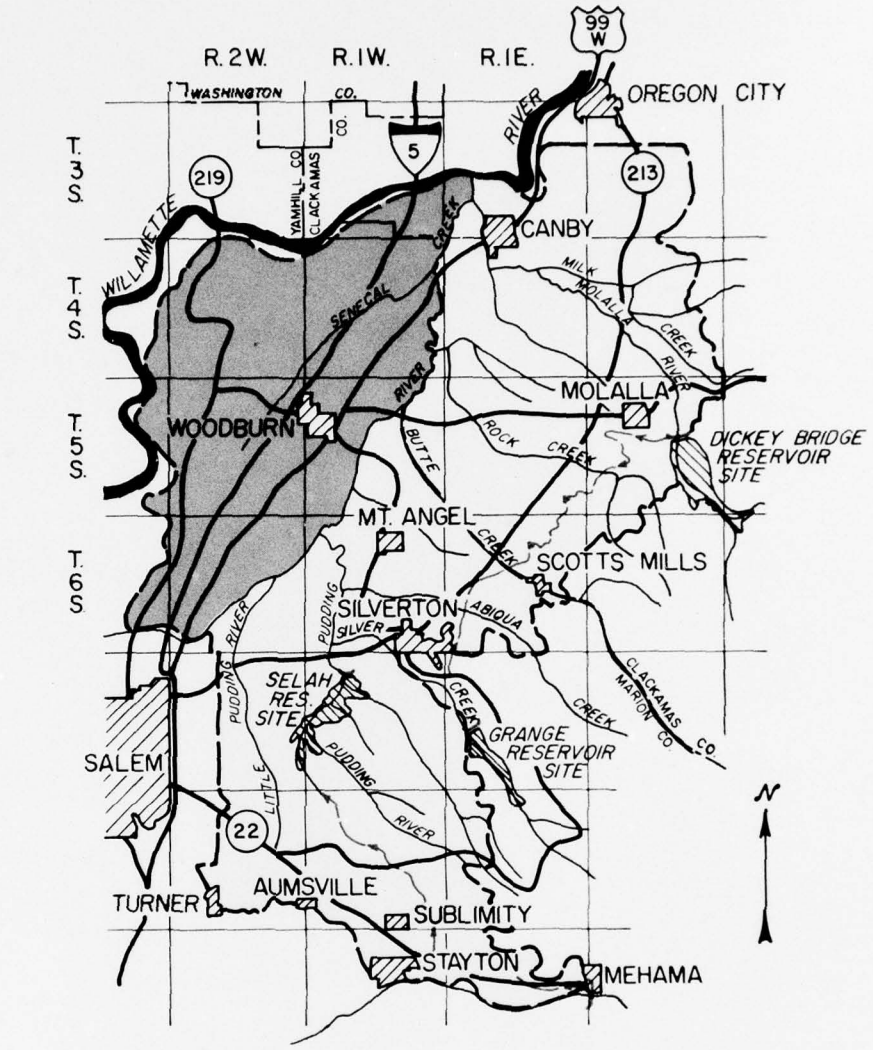
Molalla Division

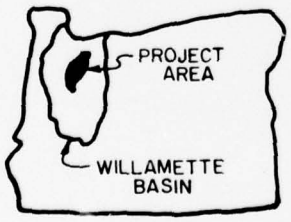
a. Location. - The Molalla Division is located in Marion and Clackamas Counties, generally covering the Molalla and Pudding Rivers drainages. Portland is about 25 miles north of the Division. Map V-12 shows project location and approximate size.

b. Functions. - This Division would be a multipurpose development to serve the functions of flood control, irrigation, recreation, and fish and wildlife enhancement. Pollution control would not be a specific project function; however, the bulk of water quality needs would be met through operation of the proposed reservoirs. There is a power generation potential, but further studies will be required to determine whether it should be developed.

c. Plan. - Under the plan of development, three reservoirs--Dickey Bridge on Molalla River, Grange on Silver Creek, and Selah on Pudding River--would be operated for water control and conservation purposes. The combined total capacity of the three reservoirs would be about 375,000 acre-feet. In addition to the new storage reservoirs, use of stored water from the existing Detroit Reservoir on North Santiam River would meet a sizable portion of the irrigation needs.

Irrigation water is planned to be delivered to about 100,000 acres of project lands through buried pressure pipelines--55,000 acres to be served from new storage development and 45,000 acres from existing Federal storage on North Santiam River. Pumping would be provided where gravity alone would not provide adequate pressure. Several large canals





KEY MAP

LEGEND

- IRRIGATION SERVICE AREA
- POTENTIAL GROUNDWATER SERVICE AREA
- PROJECT BOUNDARY
- MAIN CANAL
- DIVERSION DAM

0 1 2 3 4 5 6

SCALE IN MILES

MAP V-12

WILLAMETTE RIVER PROJECT OREGON
MOLALLA DIVISION

would serve as the main arteries of the distribution system. The principal canal would run between Grange and Dickey Bridge Reservoirs. Another would head at a new diversion structure on North Santiam River and terminate at the head of Selah Reservoir on Pudding River. Appropriate drainage facilities are also included in the plan.

Dickey Bridge and Grange Reservoirs would be operated to control 100-year floods at the respective sites, while Selah Reservoir would control floods of a smaller magnitude at that site.

Year-round releases would be made from Dickey Bridge and Grange Reservoirs to meet optimum flow requirements for fish. Minimum-fish-flow requirements in Pudding River would be satisfied by the combined effect of Grange Reservoir releases, tributary inflow, and releases from Selah Reservoir on Pudding River.

Water-oriented recreational opportunities would be created at the three reservoirs. Recreation facilities would be provided around the reservoirs to accommodate a combined initial annual use of 414,000 recreation-days and 2,070,000 recreation-days ultimately.

d. Project Features. -

Storage

All three dams would be earthfill structures with impervious cores. Locations, dimensions, and capacities are shown in the following summaries:

Site	Site No.	Stream	R. Mile	Location Sec.	T.	R.
Dickey Br.	348	Molalla R.	21.1	14	5S	2E
Grange	352	Silver Cr.	9.1	19	7S	1E
Selah	386	Pudding R.	50.6	5	7S	1W

Name	Dimensions, feet Height 1/	Length	Storage Cap., ac.-ft. Dead and Inactive	Total	Surface Area, Acres
Dickey Br.	229	4,380	20,000	273,000	2,650
Grange	280	1,100	10,000	80,000	680
Selah	66	2,310	2,000	22,000	1,400
Totals			32,000	375,000	4,730

1/ *Above streambed.*

Dickey Bridge Reservoir site contains several homes, a logging operation, and considerable agricultural land. Relocation of county roads and utility lines would be required.

Grange Reservoir site is in a deep canyon which contains very few buildings or roads that would require relocating. Only a small portion of the area is presently cultivated.

Selah Reservoir would inundate an area which is primarily agricultural. A number of houses are located in the area as well as several county roads and a cemetery.

Distribution facilities would consist of canals, pumping plants, and pipelines. Drainage facilities would also be developed as needed. The specific mileages and dimensions for the distribution facilities will be determined in future studies.

e. Hydrology. - Dams at the three sites would control runoff from a total area of 303 square miles, or 35 percent of the Molalla-Pudding drainage basin. Based on records for the 40-year period from 1929 through 1968, water yields at the damsites are:

Site	Drainage Area, Sq.Mi.	Annual Runoff, ac.-ft. Max.	Min.	Average
Dickey Br.	204	1,101,000	375,000	640,000
Grange	40	213,000	87,000	139,000
Selah	59	N/A	N/A	116,000
Totals	303			895,000

In addition to the storable runoff at the three reservoir sites, an annual average of about 118,000 acre-feet of stored water would be diverted into the subbasin from North Santiam River for irrigation purposes.

Minimum and maximum natural mean monthly flows at the dam sites are :

Site	Mean Monthly Flow, cfs Min.	Max.
Dickey Bridge	43	4,410
Grange	4	968
Selah	N/A	N/A

f. Economic analysis. - Total capital cost for the Division would be in the order of $211 million. Annual charges, based on interest at 4-5/8 percent and including operation and maintenance costs, would be

about $12.8 million. With annual benefits of about $13 million, the overall project would have a benefit-to-cost ratio of 1.07 to 1.

g. Environmental considerations. - Molalla River is one of the streams listed for management under a program for preservation of unique and desirable natural environment. That listing, in Table V-16, shows an exception to permit construction of Dickey Bridge Dam and Reservoir. That exception was made in consideration of the apparent overriding need for services, including improvement of downstream environment, for which no alternative means of satisfaction could be found. However, before any recommendation for Congressional authorization is made, full consideration and coverage of impacts on environmental resources and needs will be required. Such consideration and coverage would be consistent with the requirements of PL 91-190, the National Environmental Policy Act of 1969.

Tualatin Project, Second Phase

a. Location. - The project is located in Tualatin River basin in Washington County, near the Cities of Hillsboro and Forest Grove. It is about 20 miles west of the metropolitan area of Portland. Map V-13 shows project location and approximate size.

b. Functions. - The plan for this project would provide for multi-purpose storage to serve the functions of irrigation, fish and wildlife enhancement, municipal and industrial water supply, recreation, water quality control, and incidental flood control.

c. Plan. - The Second Phase is an extension of the USBR Tualatin Project which is authorized for construction. Two reservoirs, Gaston on Tualatin River, and East Fork Dairy Creek on that stream, would be constructed to provide a combined storage capacity of 115,000 acre-feet to meet the demands of project functions. Irrigation water would be released into the streams below the dams to serve about 30,000 acres of project lands.

Heaviest project M&I water use would be in the western part of the Portland service area. Twenty-thousand acre-feet of "raw water" would be made available in Gaston Reservoir with delivery and treatment the responsibility of the contracting municipalities.

Recreation facilities at the reservoirs would accommodate an estimated annual use of 245,000 initial and 875,000 ultimate recreation days.

Although neither reservoir would be operated specifically for flood control, both would provide some flood protection. Flood control benefits would occur primarily on Tualatin River, in the reach below the dam, and on East Fork Dairy Creek. Construction of the channel-improvement works proposed by the Corps of Engineers would permit realization of reservoir-associated flood control benefits downstream along Tualatin River.

Storage would be included in Gaston Reservoir for water quality purposes. Water would be released at the dam to augment flows and provide water of suitable quality in Tualatin River until year 2020.

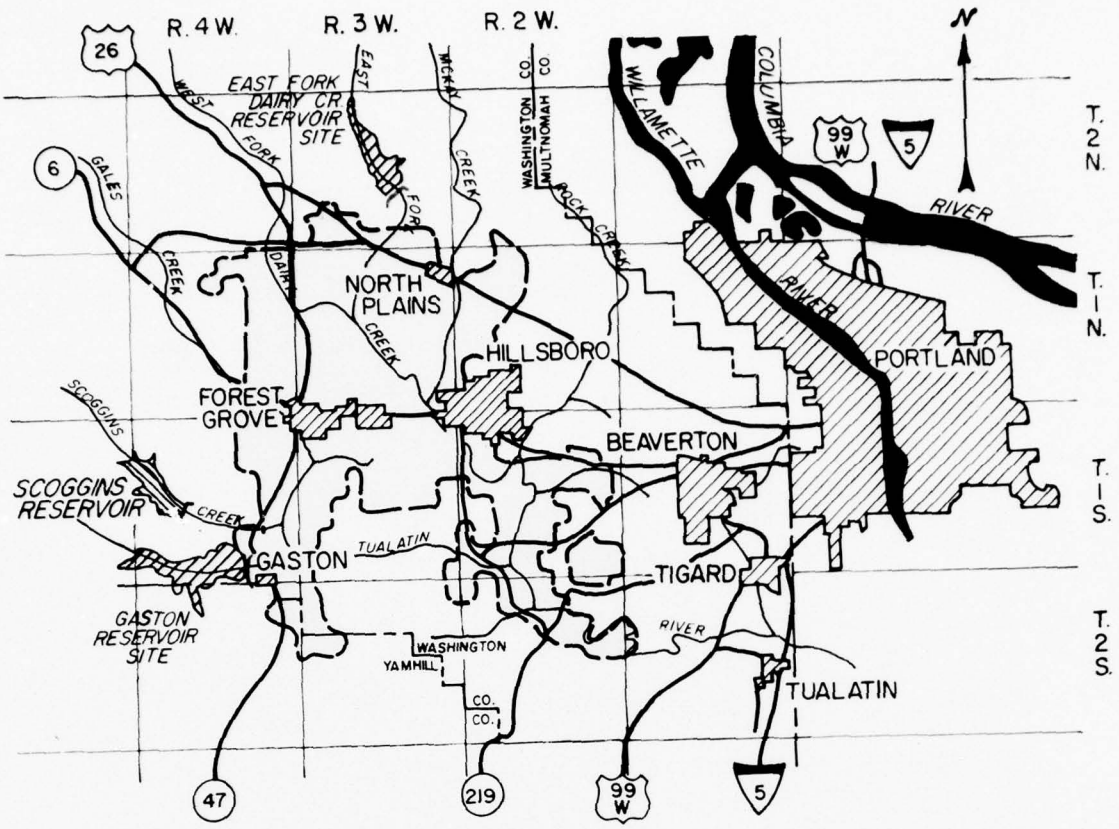
d. Project features. - In addition to the two earthfill dams, seven pumping plants, two on East Fork Dairy Creek and five on Tualatin River, are included. A pressure-pipe system would provide water at sprinkler pressure to individual farms. Dam and reservoir locations, dimensions, and capacities are shown in the following summaries:

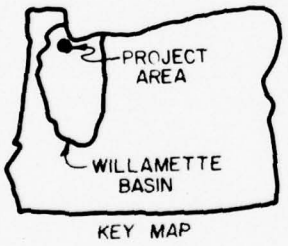
Site	Site No.	Stream	R. Mile	Location Sec.	T.	R.
Gaston	422	Tualatin R.	65.7	34	1S	4W
E. Fk. Dairy	417	E. Fk. Dairy Cr.	9.0	22	2N	3W

Name	Dimensions, feet Height 1/	Length	Storage Cap., ac.-ft. Dead and Inactive	Total	Surface Area, acres
Gaston	86	2,600	5,000	68,000	1,720
E. Fk. Dairy	94	2,900	8,000	47,000	1,030
Totals	-	-	13,000	115,000	2,750

1/ Above streambed

Gaston Reservoir would inundate a large portion of the agricultural lands of Patton Valley and a number of homes and farm buildings. Relocation would be required for some sections of Patton Valley Road, several county roads, power lines, and a waterline for the City of Hillsboro.





LEGEND

IRRIGATION SERVICE AREA

IRRIGATION SERVICE BOUNDARY

0 1 2 3 4 5 6

SCALE IN MILES

MAP V-13

WILLAMETTE RIVER PROJECT OREGON
TUALATIN PROJECT
SECOND PHASE

East Fork Dairy Creek Reservoir would inundate an area of which about 40 percent is in timber and brush. The bulk of the remaining lands are pasture with a moderate number of houses scattered throughout. A section of county road, power lines, and several secondary roads would have to be relocated.

e. Hydrology. - Dams at the two sites would control runoff from a total area of about 94 square miles, or about 13 percent of the Tualatin drainage basin. Together with the authorized Scoggins Dam in the first phase, the two dams would control runoff from about 133 square miles or 19 percent of the total area. Based on records for the 36-year period from 1929 through 1964, the water yields at the dam sites are:

Site	Drainage Area, sq. mi.	Annual Runoff, ac.-ft.		
		Max.	Min.	Average
Gaston	52	222,000	76,000	135,000
E. Fk. Dairy	42	125,000	40,000	74,000
Totals	94	347,000	116,000	209,000

Minimum and maximum natural mean monthly flows at the dam sites are:

Site	Mean Monthly Flow, cfs	
	Min.	Max.
Gaston	2	925
E. Fk. Dairy	3	550

f. Economic analysis. - Total capital cost for the second phase would be in the order of $63 million. Annual charges, based on interest at 4-5/8 percent and including operation and maintenance cost, would be about $3.9 million. With average annual benefits of about $4.2 million, the second phase would have a benefit-to-cost ratio of 1.08 to 1.

g. Environmental considerations. - Tualatin River is one of the streams listed for management under a program for preservation of unique and desirable natural environment. That listing, in Table V-16, shows an exception to permit construction of Gaston Dam and Reservoir. That exception was made in consideration of the apparent overriding need for

services, including improvement of downstream environment, for which no alternative means of satisfaction could be found. However, before any recommendation for Congressional authorization is made, full consideration and coverage of impacts on environmental resources and needs will be required. Such consideration and coverage would be consistent with the requirements of PL 91-190, the National Environmental Policy Act of 1969.

South Yamhill Division

a. Location. - This division is located in Yamhill and Polk Counties, along South Yamhill and Willamette Rivers, between the Carlton and Red Prairie Divisions. Map V-14 shows project location and approximate size.

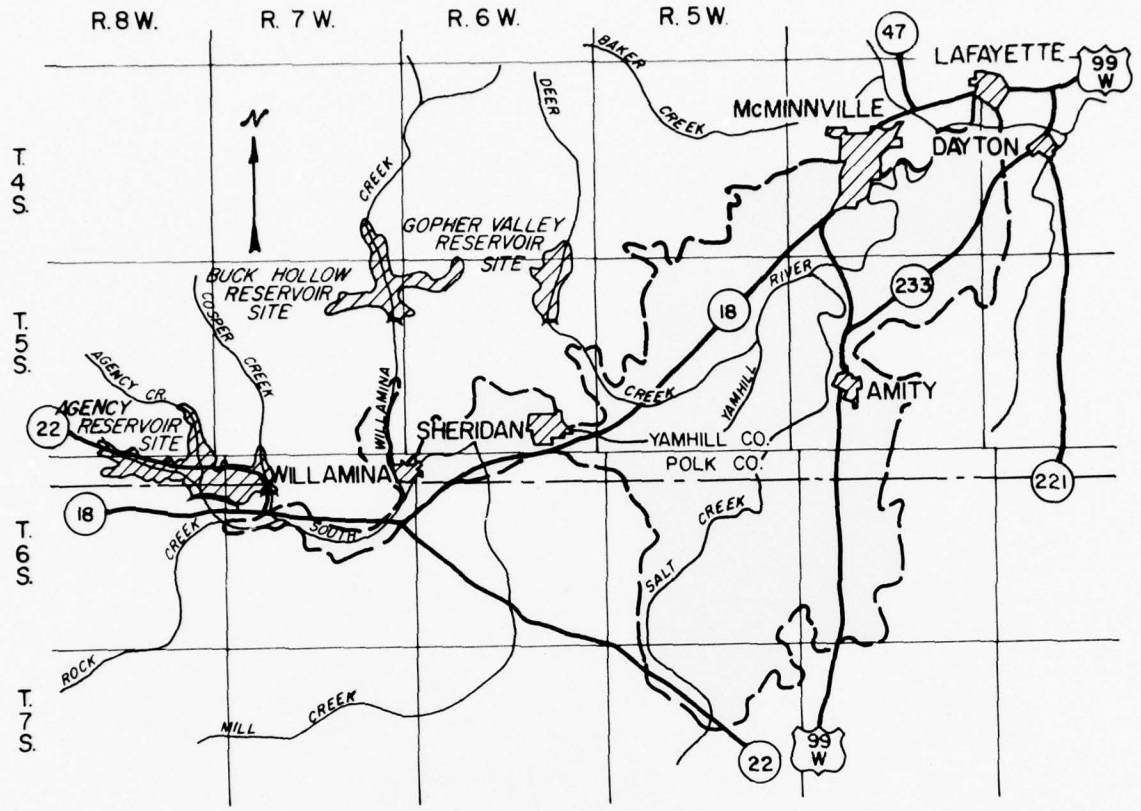
b. Functions. - The plan for this division would provide for multipurpose storage to serve the functions of flood control, irrigation, recreation, and fish and wildlife.

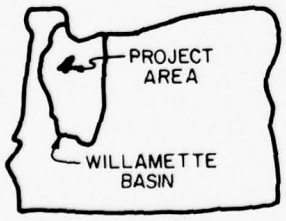
c. Plan. - Three reservoirs, Buck Hollow on Willamina Creek, Agency on South Yamhill River, and Gopher Valley on Deer Creek, are designed to store a total of 195,000 acre-feet to meet the demands of project functions. Irrigation water would be released into the stream at each dam. About 50,000 acres would be served by pipe distribution with water delivered at sprinkler pressure. Projections indicate that annual recreational use of the three reservoirs will begin at 324,000 recreation-days and will ultimately reach 1,880,000 days.

The reservoirs would be operated to control a 100-year frequency flood at each site.

Water would be released at each of the dams year-round to provide optimum fishery flows in South Yamhill River and in Willamina Creek.

d. Project features. - In addition to the three earthfill dams, three pumping plants and associated distribution systems would be constructed, two on South Yamhill River and one on Deer Creek. Dam and reservoir locations, dimensions, and capacities are shown in the following summaries:





KEY MAP

LEGEND

IRRIGATION SERVICE BOUNDARY

IRRIGATION SERVICE AREA

0 1 2 3 4 5

SCALE IN MILES

MAP V-14

WILLAMETTE RIVER PROJECT OREGON
SOUTH YAMHILL DIVISION

Site	Site No.	Stream	R. Mile	Location Sec.	T.	R.
Buck Hollow	261	Willamina Cr.	7.0	12	5S	7W
Agency	253	S. Yamhill R.	54.5	12	6S	8W
Gopher Valley	269	Deer Cr.	9	11	5S	6W

Name	Dimensions, feet Height 1/	Length	Storage Cap., ac.-ft. Dead and Inactive	Total	Surface Area, Acres
Buck Hollow	200	1,100	10,000	84,000	1,120
Agency	95	6,900	12,000	78,000	2,520
Gopher Valley	110	1,025	4,000	33,000	915
Totals			26,000	195,000	4,555

1/ Above streambed

The Gopher Valley site could be developed under other Federal programs and a local group is investigating the opportunities afforded by PL 84-984 and PL 83-566. Under PL 84-984, it is reported the reservoir capacity would be similar to that shown above. However, the PL 83-566 approach would result in a smaller reservoir, to be operated in combination with a reservoir at the Muddy Creek site, as described in subsequent text on Deer Creek Watershed Project. Combined capacity of those reservoirs would be about 36,000 acre-feet. The South Yamhill Division plan could be modified if either of these alternative approaches is chosen.

Buck Hollow Reservoir site is predominantly uncleared land and has only a moderate number of houses located within the reservoir area. Some county roads and local power transmission lines would require relocation.

Agency Reservoir site would inundate a primarily agricultural area. A large number of buildings are located within the reservoir. State Highway 22, county roads, and BLM roads traverse a portion of the reservoir area and would require relocation.

Gopher Valley site would inundate an area which contains a moderate number of houses and farm buildings and which is about 50 percent cleared and 50 percent timbered and cut-over. Only a few miles of dirt and gravel roads would need to be relocated.

e. Hydrology. - Dams at the three sites involved would control runoff from a total area of 147 square miles, or 28 percent of the South Yamhill drainage basin. Based on records for the 41-year period from 1926 through 1966, water yields at the dam sites are:

Site	Drainage Area, sq. mi.	Annual Runoff, ac.-ft.		
		Max.	Min.	Average
Buck Hollow	61	282,000	91,000	169,000
Agency	64	306,000	118,000	200,000
Gopher Valley	22	88,000	34,000	67,000
Totals	147	676,000	243,000	436,000

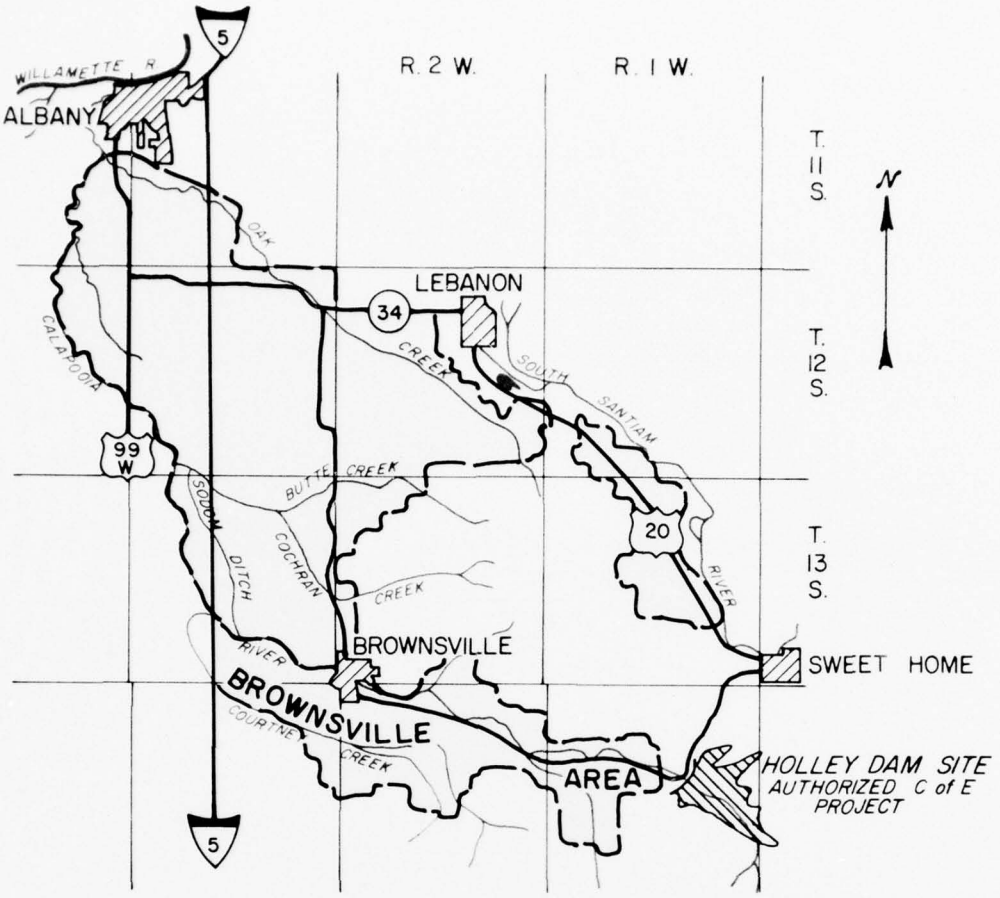
Minimum and maximum natural mean monthly flows at the dam sites are:

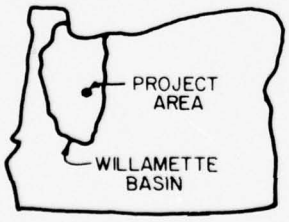
Site	Mean Monthly Flow, cfs	
	Min.	Max.
Buck Hollow	7	1,330
Agency	5	1,510
Gopher Valley	0	437

f. Economic analysis. - Total capital cost for the Division (including the Gopher Valley development) would be in the order of $99 million. Annual charges, based on interest at 4-5/8 percent and including operation and maintenance costs, would be about $6 million. With average annual benefits of about $7.2 million, the overall project would have a benefit-to-cost ratio of 1.2 to 1.

Calapooia Division - Brownsville Area

a. Location. - The Calapooia Division of the Willamette River Project is located generally between Calapooia River and Oak Creek in Linn County southeast of Albany. Brownsville Area, the early-action portion of this division, extends along Calapooia River from the Holley damsite downstream to Interstate Highway 5. Map V-15 shows project location and approximate size.





KEY MAP

LEGEND

IRRIGATION SERVICE AREA

IRRIGATION SERVICE BOUNDARY

0 1 2 3 4 5 6

SCALE IN MILES

MAP V-15

WILLAMETTE RIVER PROJECT OREGON
CALAPOOIA DIVISION

b. Functions. - Under the plan of development, this would be a single-purpose irrigation project.

c. Plan. - The Brownsville Area would use water stored in the authorized Holley Reservoir on Calapooia River. Under the plan, water would be released at the dam into the stream channel from which it would be pumped to irrigate 8,700 acres in the vicinity of Brownsville. The remaining 39,000 acres of potentially irrigable land in the Calapooia Division are expected to be developed later using water stored in Federal reservoirs on South Santiam River. That portion of the division is included in the long-range phase.

d. Project features. - Project features would include two pumping plants on Calapooia River and pipeline distribution systems which would deliver water to each farmstead at sprinkler pressure. A drainage system also would be provided.

e. Economic analysis. - The capital cost for the Brownsville Area of the Calapooia Division would be about $9.7 million. Annual cost, based on 4-5/8 percent interest and including operation and maintenance, would be less than $0.7 million. With average annual irrigation benefits of more than $0.8 million, the project would have a benefit-to-cost ratio of 1.26 to 1.

Projects Studied by Soil Conservation Service

Twenty-six of the early-action project elements of the comprehensive basin plan have been studied by the Soil Conservation Service.

Total cost of the 26 early-action watershed projects is estimated at $59.2 million, of which about $32.5 million would be provided by non-Federal project sponsors. The total cost is comprised of $10.0 million for land treatment, $48.2 million for structural measures, and $1.0 million for completion of planning. Annual operation and maintenance costs, all non-Federal, would be in the order of $0.4 million.

Structural Measures

Structural measures consist of 39 reservoirs with a combined storage capacity and surface area of 325,500 acre-feet and 11,560 acres, respectively. Embankment required for the 39 damsites is estimated at nearly 20,000,000 cubic yards. Total cost of the reservoirs is estimated at

$33.9 million. Reservoir storage would be provided in 20 of the 26 projects.

Facilities for water-based recreation would be provided at 18 of the reservoir sites. Facilities include boat ramps, picnic grounds, parking, swimming areas, and sanitary facilities to serve an estimated initial use of 988,000 visitor-days annually. Total cost of the recreation facilities to be developed in 17 of the 26 projects is estimated at $3.6 million.

Improvement of natural channels will be involved in 17 of the 26 projects. Twelve projects will require channel improvements in combination with reservoir storage to evacuate flood flows. Capacities and depths will be provided in the channels of 11 projects to serve the dual purposes of flood prevention and drainage. In total, nearly 187 miles of improvements would be made at an estimated cost of $5.2 million.

Distribution facilities would be provided in 19 of the 26 projects for the irrigation of slightly less than 60,000 acres. Approximately 33,000 acres would be supplied from PL 83-566 storage, 4,000 from existing Federal storage, 7,000 from natural flow, 8,000 from either PL 83-566 or USBR storage, and 8,000 from either PL 83-566 or existing Federal storage. Distribution facilities would consist of combinations of natural channels, canals or pipelines, and are estimated to cost a total of $5.6 million.

Project Effects

Flood damages in the 26 projects occur on nearly 36,000 acres annually and are estimated at $707,000. The proposed reservoirs and channel improvements would reduce damages by 65 percent in 20 of those projects. Damage reduction and flood prevention benefits as a result of project proposals are estimated to be $506,000 annually. Reservoirs with flood storage in proposed watershed projects provide about 10 percent of the basin's drainage area controlled accomplishment above Willamette Falls and 3 percent of the effective storage accomplishment for the early action.

Drainage restrictions limit agricultural production on slightly more than 202,000 acres in the 26 projects. Deepening and enlarging of 111 miles of multiple-purpose channels in 11 projects will provide improved outlets benefiting approximately 94,000 acres. Drainage benefits are estimated to be $234,000 annually.

Irrigated crops are grown on approximately 39,000 acres in the 26 projects, with about 6,000 acres experiencing water shortages annually. An additional 240,000 acres are suitable for irrigation but currently are dry cropped. Project proposals in 20 of the 26 projects would provide a full season water supply and distribution system for irrigation of nearly 60,000 additional acres. Irrigation benefits are estimated to be $1,650,000 annually.

Water-based recreation facilities are in short supply in the northern and western portions of Willamette Basin. Projections to 1980 indicate present facilities would be deficient by more than 9 million visitor-days annually. Recreation facilities proposed in 17 of the 26 projects would provide nearly 990,000 visitor-days of this demand with benefits estimated at about $990,000 annually.

Storage for nonagricultural purposes such as rural-domestic water supply, fish and wildlife enhancement, M&I water supply, and low-flow augmentation is included in 13 of the 26 projects. Approximately 31,000 acre-feet, or 10 percent of the total storage capacity, was allocated to those purposes. Benefits were assumed to be equal to the cost of providing the storage and were estimated to be $168,000 annually. Storage in these projects could contribute rather significantly to meeting summer low flow requirements in many of the subbasins. Percent satisfaction of low flow requirements would range from about 64 percent in the Long Tom Subbasin to 16 percent in the Coast Fork, and down to about 2 percent for the Willamette below Salem.

Total benefits for all purposes, including approximately $78,000 for local secondary, are calculated to be $3,625,000 annually. Annual costs, including operation and maintenance, were evaluated at both the 3-1/4 percent and 4-5/8 percent interest rates. These rates resulted in annual costs of $2,031,000 at 3-1/4 percent, $2,651,000 at 4-5/8 percent and B-C ratios of 1.8 and 1.4 to 1, respectively.

Watershed studies were made in accordance with the basic requirements of PL 83-566, as amended, and appropriate National policy directives. Planning to date has been done in cooperation with the Oregon Association of Soil and Water Conservation Districts, the potential individual project sponsors, and other agencies.

Watershed Investigation Reports, for each project, have been prepared and provide the basis for this presentation. The following paragraphs summarize information on each of the 26 watershed projects.

Camas Swale Watershed Project

The Camas Swale project is one of two in Coast Fork Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Upper Willamette SWCD. About 67 percent of the 28,800-acre area is in forest and woodland. In total, 90 farms are involved. There are about 400 acres of irrigated cropland, 3,600 acres of nonirrigated cropland, and 4,000 acres of pasture.

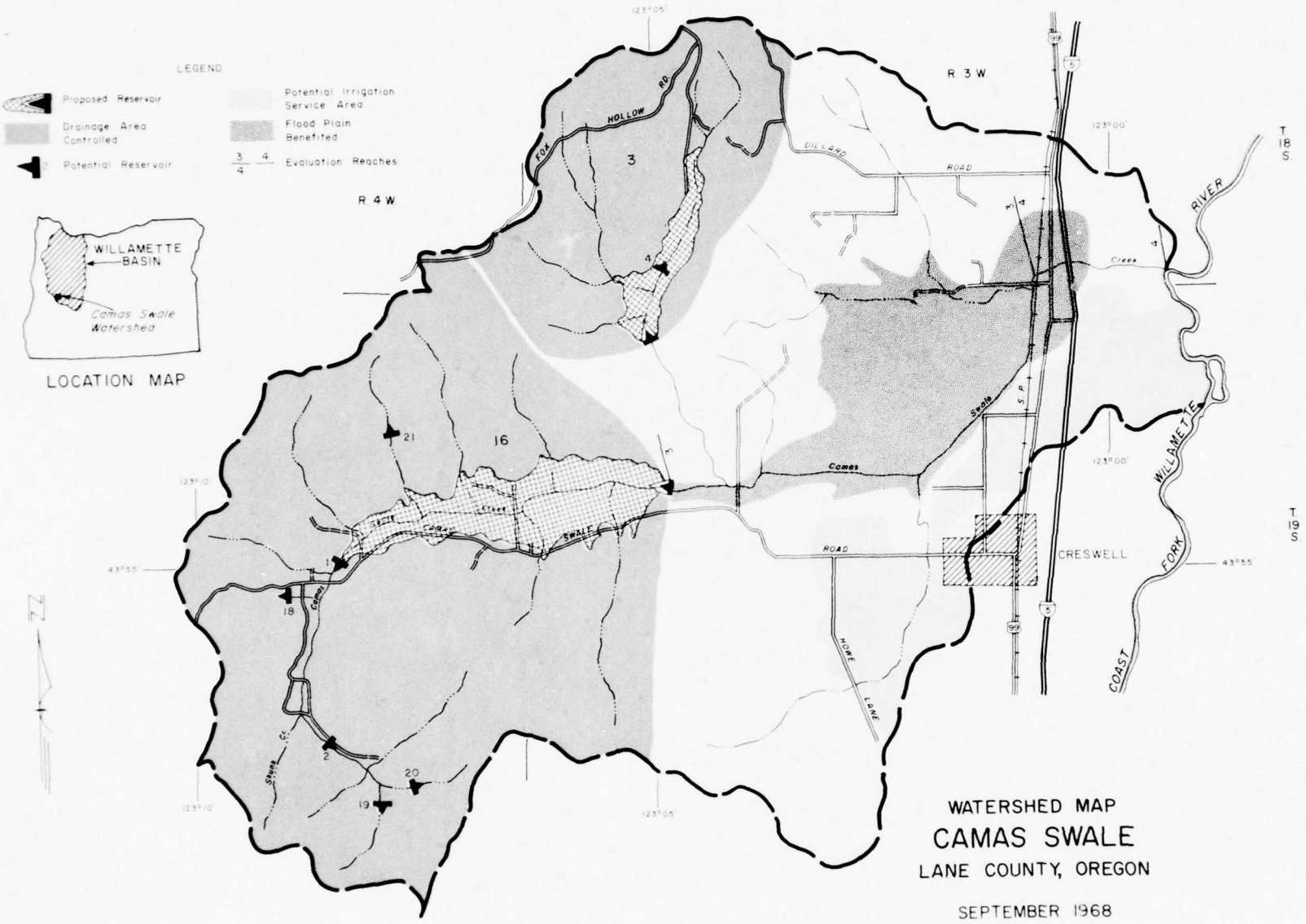
a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 22,400 acre-feet; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 17 (SCS 3) in Section 5, Township 19 South, Range 3 West. Tributary drainage area would be about 5.8 square miles with an average annual yield of 9,300 acre-feet. A dam about 70 feet in height would raise the water surface to about elevation 645 feet, m.s.l., and create a reservoir with a storage capacity of about 6,400 acre-feet and a surface area of 270 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply to watershed lands; that service would be alternative to contracting for use of stored water diverted from existing upstream Federal storage, and local decision would be required prior to construction.

(2) A second reservoir would be at site No. 26 (SCS 16) in Section 8, Township 19 South, Range 3 West. Tributary drainage area would be about 16.7 square miles with an average annual yield of 22,300 acre-feet. A dam about 45 feet in height would raise the water surface to about elevation 595 feet, m.s.l., and create a reservoir with a storage capacity of about 16,000 acre-feet and a surface area of 800 acres. The reservoir would provide storage for reduction of flood damages in the watershed. Recreation facilities would be provided to serve the estimated initial annual use.

(3) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,600 acres to 900 acres and reduce flood damages by 50 percent. Recreation facilities at site No. 26 would serve an initial use estimated at 50,000 visitor-days annually including


LEGEND
Proposed Reservoir
Drainage Area Controlled
Potential Reservoir
Potential Irrigation Service Area
Flood Plain Benefited
3/4 Evaluation Reaches
WILLAMETTE BASIN
Camas Swale Watershed
LOCATION MAP
R. 4 W
R. 3 W
T 18 S.
T 19 S.
123°05'
123°00'
123°10'
43°55'
HOLLOW RD
FOX
DILLARD
ROAD
RIVER
Creek
Swale
S. P.
Camas
CRESWELL
WILLAMETTE
FORK
COAST
HOME
LANE
Silver Ct.
16
21
18
19
20
1
2
3
4
5
99
WATERSHED MAP
CAMAS SWALE
LANE COUNTY, OREGON
SEPTEMBER 1968
SCALE IN MILES

M7-0-20856-1

a reservoir fishery. A full irrigation supply would be provided for 1,430 acres.

Additional storage in the reservoirs would provide in the order of 4,050 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $1.9 million, of which about $1.7 million would be for structural measures. Of the total cost, approximately $0.8 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $117,000 and $64,000 respectively, for a B:C ratio of 1.8 to 1.0, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.4 to 1.

e. Current Status. - An application for assistance was submitted in 1963. Sponsors currently include Upper Willamette SWCD, Lane County, City of Creswell, Mid-Lane SWCD, Upper Willamette RC&D, and Oregon Association of SWCD's.

Cloverdale Watershed Project

The Cloverdale project is one of two in Coast Fork Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Upper Willamette SWCD. About 75 percent of the 21,130-acre area is in forest and woodland. In total, 70 farms are involved. There are about 1,000 acres of irrigated cropland, 1,800 acres of nonirrigated cropland, and 2,100 acres of pasture.

a. Proposed Structural Measures. - The project would consist of a reservoir with a capacity of 9,000 acre-feet, channel improvements for flood control and drainage, an irrigation distribution system, and basic recreation facilities.

(1) The reservoir would be at site No. 25 (SCS 15) in Section 32, Township 18 South, Range 2 West. Tributary drainage area would be about 7.5 square miles with an average annual yield of 13,200 acre-feet. A dam about 80 feet in height would raise the water surface to about elevation 600 feet, m.s.l., and create a reservoir with a storage capacity of about 9,000 acre-feet and a surface area of 330 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply to watershed lands; that service would be alternative to contracting for use of stored water diverted from existing upstream Federal storage, and local decision would be required prior to construction. Recreation facilities would be provided to serve the estimated initial annual use.

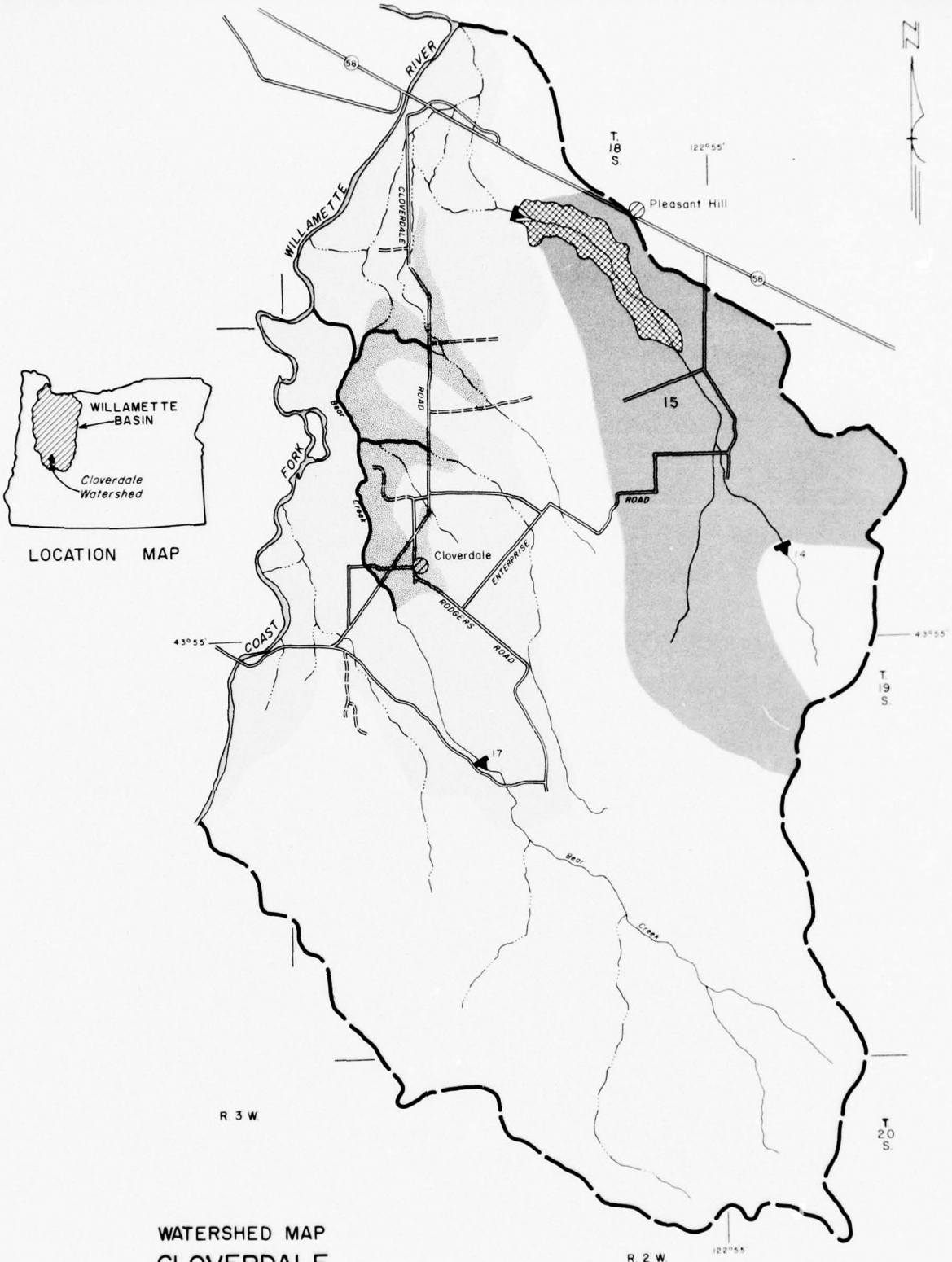
(2) Channel improvements totaling about 4.3 miles in length would be made on Bear Creek and two tributaries. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(3) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 470 acres to 90 acres and reduce flood damages by 72 percent. Recreation facilities at the reservoir site would serve an initial use estimated at 15,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 1,800 acres.

Additional storage in the reservoir would provide in the order of 2,800 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $1.7 million, of which about $1.5 million would be for structural measures. Of the total cost, approximately $0.8 million would be borne by PL 566 funds.



WATERSHED MAP
CLOVERDALE
LANE COUNTY, OREGON

AUGUST 1968

0 1
SCALE IN MILES

LEGEND

- Proposed Channel Improvement
- Proposed Reservoir
- 17 Potential Reservoir
- Drainage Area Controlled
- Potential Irrigation Service Area
- Flood Plain Benefited

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20854-L

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $90 thousand and $60 thousand respectively, for a B:C ratio of 1.5 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.1 to 1.

e. Current Status. - An application for assistance was submitted in 1964. The Cloverdale Water Control District, formed in 1967, has legal authority to furnish assurances and participate. Sponsors currently include Upper Willamette SWCD, Cloverdale WCD, Lane County, Upper Willamette RC&D, and Oregon Association of SWCD's.

Rattlesnake Creek Watershed Project

The Rattlesnake project is the only project in Middle Fork Subbasin selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Upper Willamette SWCD. About 74 percent of the 7,490-acre area is in forest and woodland. In total, 50 farms are involved. There are about 200 acres of irrigated cropland, 900 acres of nonirrigated cropland, and 500 acres of pasture.

a. Proposed Structural Measures. - The project would consist of a diversion channel, dike, and channel improvements for flood control; and an irrigation diversion and distribution system.

(1) A diversion approximately 0.4 mile in length would bypass flood flows from approximately 60 percent of the watershed area directly to Middle Fork Willamette River.

(2) Minor channel improvements would be made within a 3.5-mile reach on Rattlesnake Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(3) Irrigation facilities would consist of a diversion structure and canal or pipeline to utilize existing Federal storage released from Lookout Point Reservoir or natural flows from the Middle Fork.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 240 acres to 60 acres and reduce flood damages by 80 percent. A full irrigation supply would be provided for 800 acres.

c. Project Costs. - The total project would cost in the order of $410 thousand, of which about $290 thousand would be for structural measures. Of the total cost, approximately $204 thousand would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $26 thousand and $24 thousand, respectively, for a B:C ratio of 1.1 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.0 to 1.

e. Current Status. - An application for assistance was submitted in 1964. Sponsors currently include Upper Willamette SWCD, Lane County, Willamette Alder Creek Improvement District, Upper Willamette RC&D and Oregon Association of SWCD's.

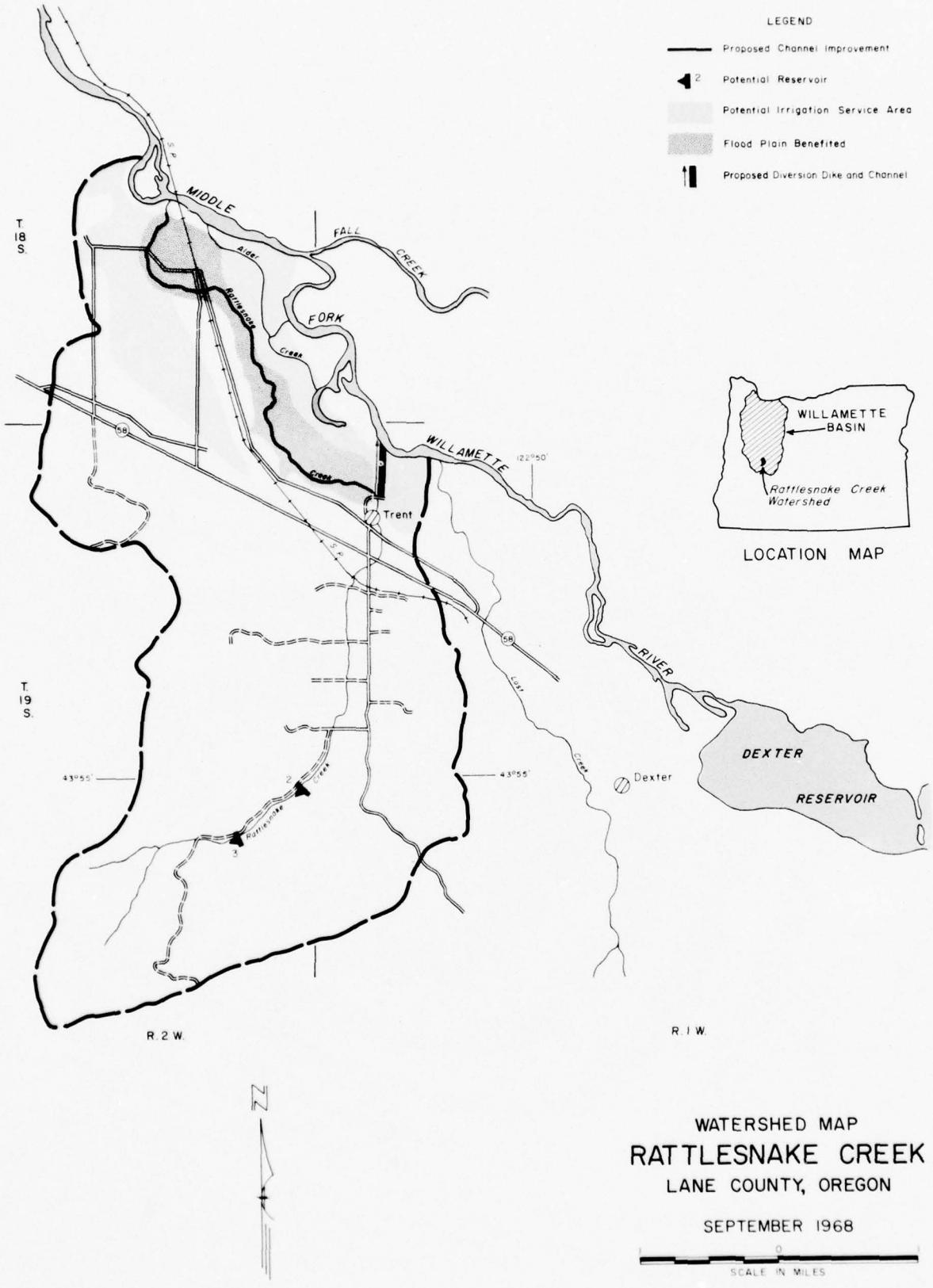
Ferguson Creek Watershed Project

The Ferguson Creek project is one of three in Long Tom Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the North Lane and Benton County SWCD's. About 46 percent of the 16,000-acre area is in forest and woodland. In total, 50 farms are involved. There are about 130 acres of irrigated cropland, 3,200 acres of non-irrigated cropland, and 5,000 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 11,700 acre-feet; channel improvements for flood control and drainage; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 134 (SCS 3) in Section 15, Township 15 South, Range 6 West. Tributary drainage area would be about 5.9 square miles with an average annual yield of 14,200 acre-feet. A dam about 100 feet in height would raise the water surface



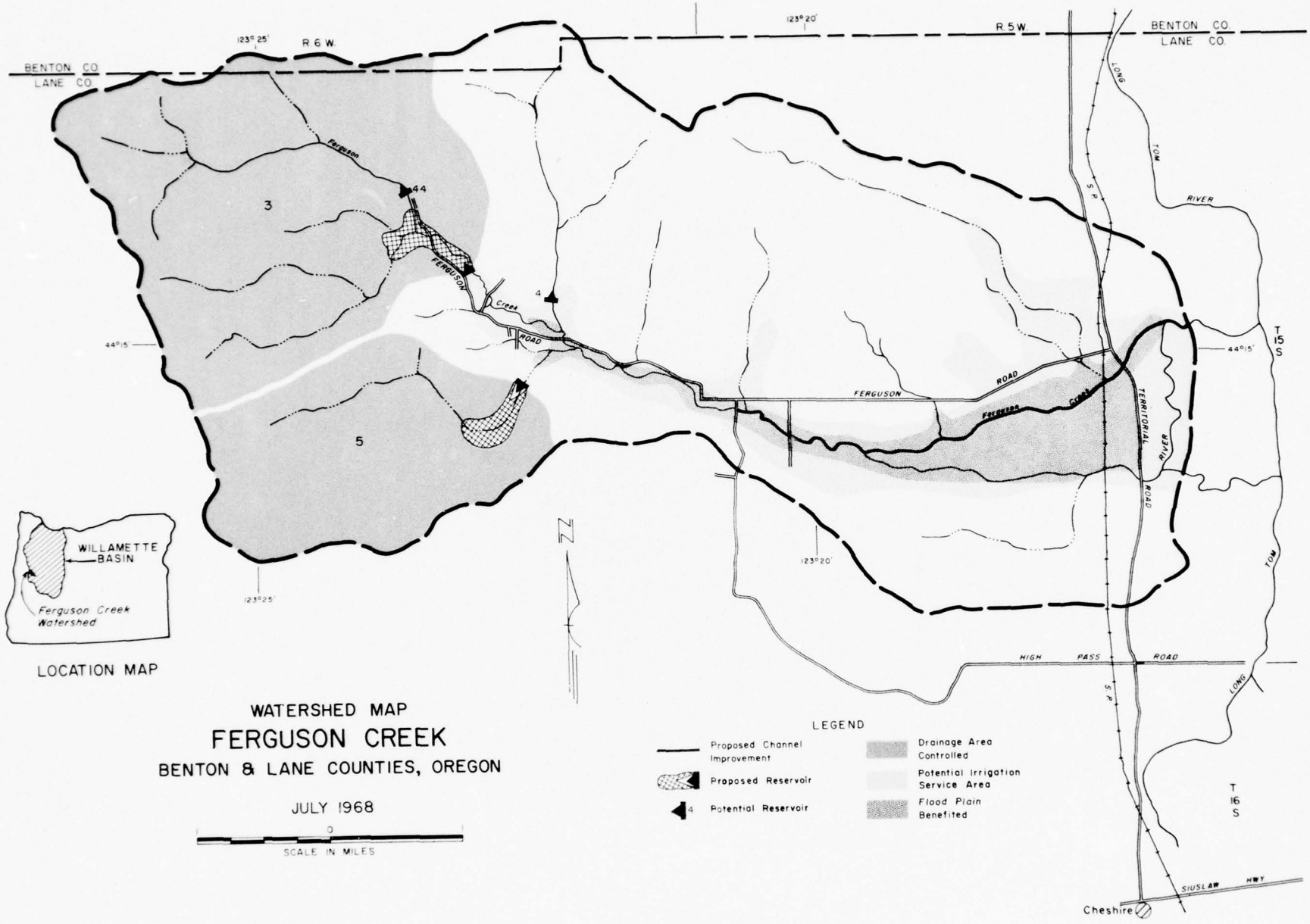
WATERSHED MAP
RATTLESNAKE CREEK
LANE COUNTY, OREGON

SEPTEMBER 1968

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

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WATERSHED MAP

FERGUSON CREEK

BENTON & LANE COUNTIES, OREGON

JULY 1968

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20848-L

to about elevation 480 feet, m.s.l., and create a reservoir with a storage capacity of about 6,000 acre-feet and a surface area of 120 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply to a portion of the watershed lands; that service would be alternative to contracting for use of stored water diverted from existing upstream Federal storage in Fern Ridge Reservoir, and local decision would be required prior to construction. Recreation facilities would be provided to serve the estimated initial annual use.

(2) A second reservoir would be at site No. 167 (SCS 5) in Section 23, Township 15 South, Range 6 West. Tributary drainage area would be about 3.2 square miles with an average annual yield of 7,700 acre-feet. A dam about 80 feet in height would raise the water surface to about elevation 445 feet, m.s.l., and create a reservoir with a storage capacity of about 5,700 acre-feet and a surface area of 130 acres. The reservoir would provide storage for reduction of flood damages in the watershed and irrigation water supply for a portion of the watershed lands.

(3) Channel improvements totaling about 4.1 miles in length would be made on Ferguson Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 640 acres to 50 acres and reduce flood damages by 78 percent. Recreation facilities at site No. 134 would serve an initial use estimated at 35,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 1,900 acres.

c. Project Costs. - The total project would cost in the order of $1.7 million, of which about $1.5 million would be for structural measures. Of the total cost, approximately $0.9 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $108 thousand and $61 thousand respectively, for a B:C ratio of 1.8 to 1, at 3-1/4 percent. With

annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.4 to 1.

e. Current Status. - Sponsors currently include North Lane SWCD, Upper Willamette RC&D, and Oregon Association of SWCD's.

Bear Creek Watershed Project

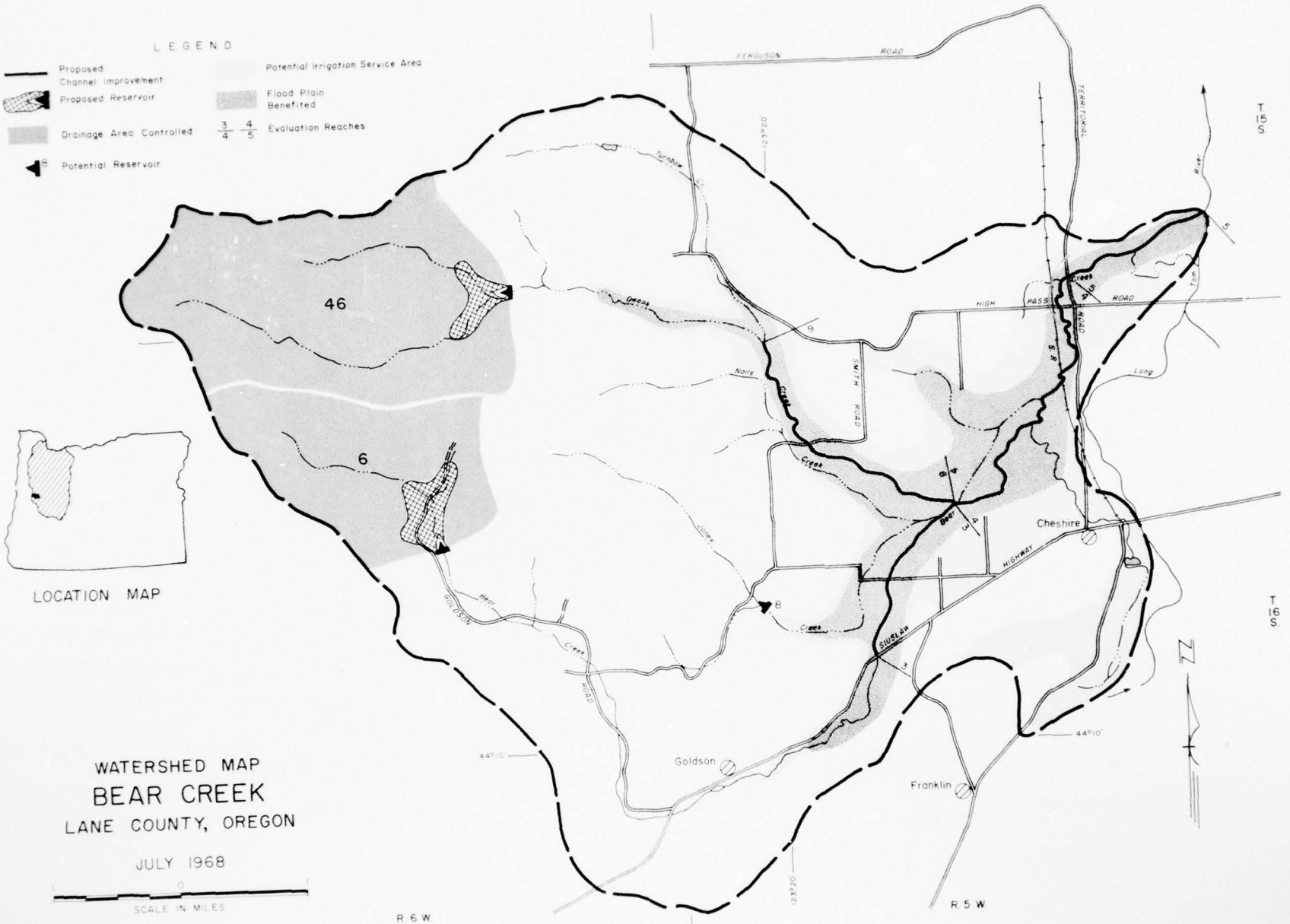
The Bear Creek project is one of three in Long Tom Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the North Lane SWCD. About 56 percent of the 14,790-acre area is in forest and woodland. In total, 70 farms are involved. There are about 800 acres of irrigated cropland, 2,200 acres of nonirrigated cropland, and 3,300 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 10,700 acre-feet, channel improvements for flood control and drainage, an irrigation distribution system, and basic recreation facilities.

(1) One reservoir would be at site No. 129 (SCS 6) in Section 11, Township 16 South, Range 6 West. Tributary drainage area would be about 1.7 square miles with an average annual yield of 3,800 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 765 feet, m.s.l., and create a reservoir with a storage capacity of about 2,500 acre-feet and a surface area of 110 acres. The reservoir would provide storage for reduction of flood damages and irrigation water supply to a portion of the watershed lands; that service would be alternative in contracting for use of stored water diverted from existing upstream storage in Fern Ridge; and local decision would be required prior to construction.

(2) A second reservoir would be at site No. 573 (SCS 46) in Section 35, Township 15 South, Range 6 West. Tributary drainage area would be about 4.2 square miles with an average annual yield of 10,100 acre-feet. A dam about 110 feet in height would raise the water surface to about elevation 545 feet, m.s.l., and create a reservoir with a storage capacity of about 8,200 acre-feet and a surface area of 130


LEGEND
Proposed Channel Improvement
Proposed Reservoir
Drainage Area Controlled
Potential Reservoir
Potential Irrigation Service Area
Flood Plain Benefited
3/4 - 4/5 Evaluation Reaches
LOCATION MAP
WATERSHED MAP
BEAR CREEK
LANE COUNTY, OREGON
JULY 1968
SCALE IN MILES
46
6
8
Cheshire
Goldson
Franklin
FERGUSON ROAD
HIGH PASS ROAD
HIGHWAY
R 6 W.
R 5 W.
T 15 S.
T 16 S.
44°10'
123°20'
M7-0-20836-L

acres. The reservoir would provide storage for reduction of flood damages and irrigation water supply for a portion of the watershed lands. Recreation facilities would be provided to serve the estimated initial annual use.

(3) Channel improvements totaling about 7.6 miles in length would be made on Bear Creek and Owens Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in the existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,100 acres to 210 acres and reduce flood damages by 82 percent. Recreation facilities at site No. 573 would serve an initial use estimated at 35,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 1,000 acres.

c. Project Costs. - The total project would cost in the order of $1.8 million, of which about $1.6 million would be for structural measures. Of the total cost, approximately $1.0 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $83 thousand and $66 thousand, respectively, for a B:C ratio of 1.3 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.0 to 1.

e. Current Status. - Sponsors currently include North Lane SWCD, Lane County, Upper Willamette RC&D, and Oregon Association of SWCD's.

Coyote-Spencer Watershed Project

The Coyote-Spencer project is one of three in Long Tom Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report in which additional details are available.

The project, as shown on the accompanying map, is located in the Mid-Lane SWCD. About 78 percent of the 67,000-acre area is in forest and

woodland. In total, 160 farms are involved. There are about 700 acres of irrigated cropland, 4,700 acres of nonirrigated cropland, and 3,300 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of approximately 20,000 acre-feet, an irrigation distribution system, and basic recreation facilities.

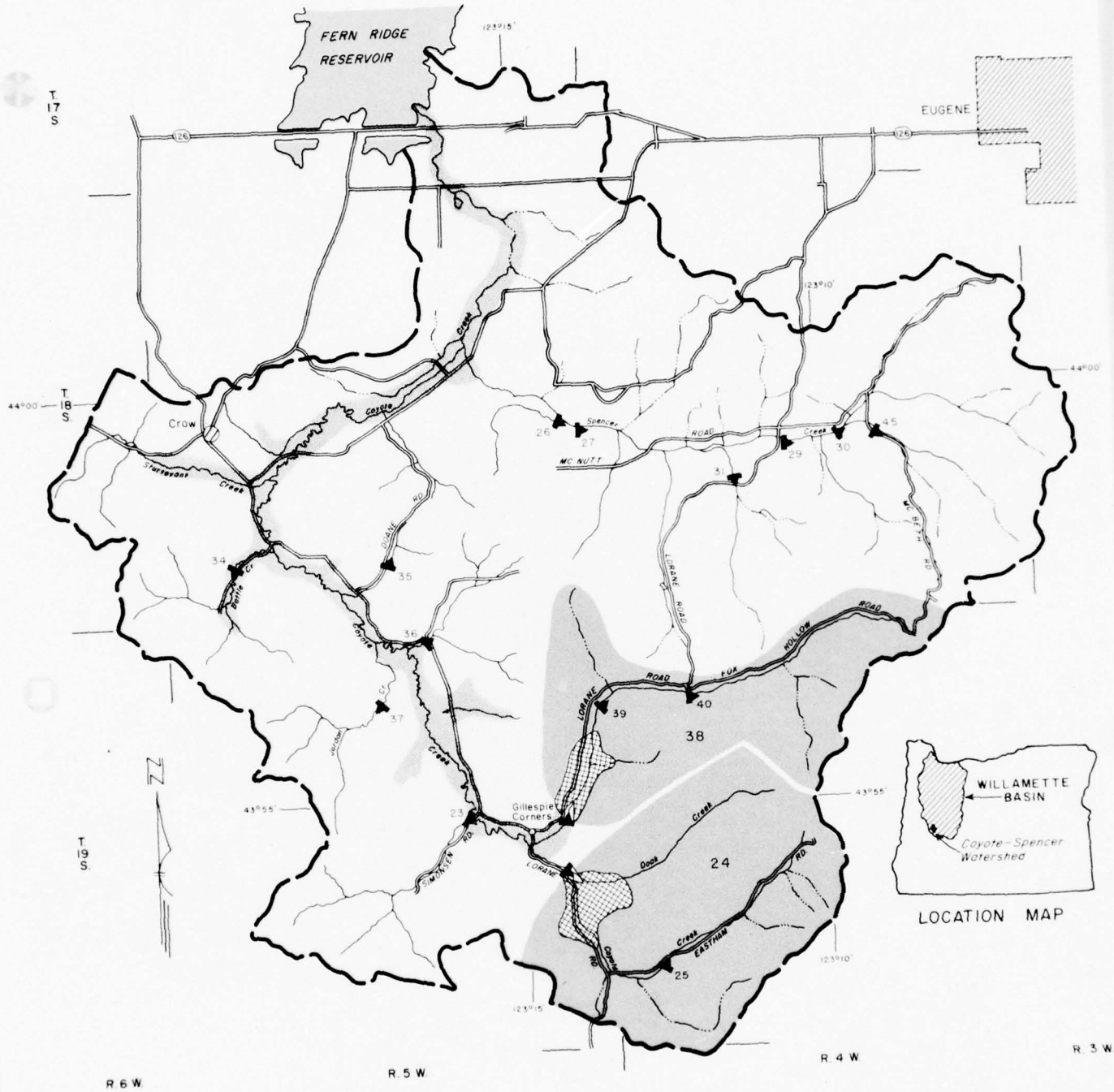
(1) One reservoir would be at site No. 130 (SCS 24) in Section 24, Township 19 South, Range 5 West. Tributary drainage area would be about 12.1 square miles with an average annual yield of 14,000 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 560 feet, m.s.l., and create a reservoir with a storage capacity of about 10,000 acre-feet and a surface area of 410 acres. The reservoir would provide storage for reduction of flood damages in the watershed. Recreation facilities would be provided to serve the estimated initial annual use.

(2) A second reservoir would be at site No. 137 (SCS 38) in Section 13, Township 19 South, Range 5 West. Tributary drainage area would be about 10.5 square miles with an average annual yield of 17,400 acre-feet. A dam about 70 feet in height would raise the water surface to about elevation 570 feet, m.s.l., and create a reservoir with a storage capacity of about 10,000 acre-feet and a surface area of 320 acres. In addition to storage for flood control, the reservoir would provide irrigation water supply to watershed lands.

(3) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,580 acres to 800 acres and reduce flood damages by 52 percent. A full irrigation supply would be provided for 2,000 acres. Recreation facilities at site No. 130 would serve an initial use estimated at 80,000 visitor-days annually, including a reservoir fishery.

Additional storage in the reservoirs would provide in the order of 2,200 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, or replacement storage for Fern Ridge Reservoir. Decisions as



LEGEND

- Proposed Reservoir
- 35 Potential Reservoir
- Drainage Area Controlled
- Potential Irrigation Service Area
- Flood Plain Benefited

WATERSHED MAP
COYOTE - SPENCER
LANE COUNTY, OREGON

SEPTEMBER 1968

SCALE IN MILES

M7-0-20853-L

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $2.6 million, of which about $2.3 million would be for structural measures. Of the total cost, approximately $1.0 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $151 thousand and $91 thousand, respectively, for a B:C ratio of 1.7 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.3 to 1.

e. Current Status. - An application for assistance was submitted in 1955. The Coyote-Spencer Water Control District, formed in 1965, has legal authority to furnish assurances and participate. Sponsors currently include Mid-Lane SWCD, Lane County, Coyote-Spencer Water Control District, Upper Willamette RC&D, and Oregon Association of SWCD's.

San-Thomas Watershed Project

The San-Thomas project is one of four in Santiam Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the East Linn SWCD. About six percent of the 7,790-acre area is in forest and woodland. In total, 25 farms are involved. There are about 300 acres of irrigated cropland, 5,800 acres of nonirrigated cropland, and 1,000 acres of pasture.

a. Proposed Structural Measures. - The project would consist of about 5.0 miles of channel improvements for flood prevention and drainage. Capacities would be provided for 3-year protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 430 acres to 90 acres and reduce flood damages by 80 percent.

c. Project Costs. - The total project would cost in the order

of $197 thousand, of which about $140 thousand would be for structural measures. Of the total cost, approximately $118 thousand would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $24 thousand and $7 thousand, respectively, for a B:C ratio of 3.3 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 2.6 to 1.

e. Current Status. - Sponsors currently include East Linn SWCD, Upper Willamette RC&D and Oregon Association of SWCD's.

Grand Prairie Watershed Project

The Grand Prairie project is one of four in Santiam Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

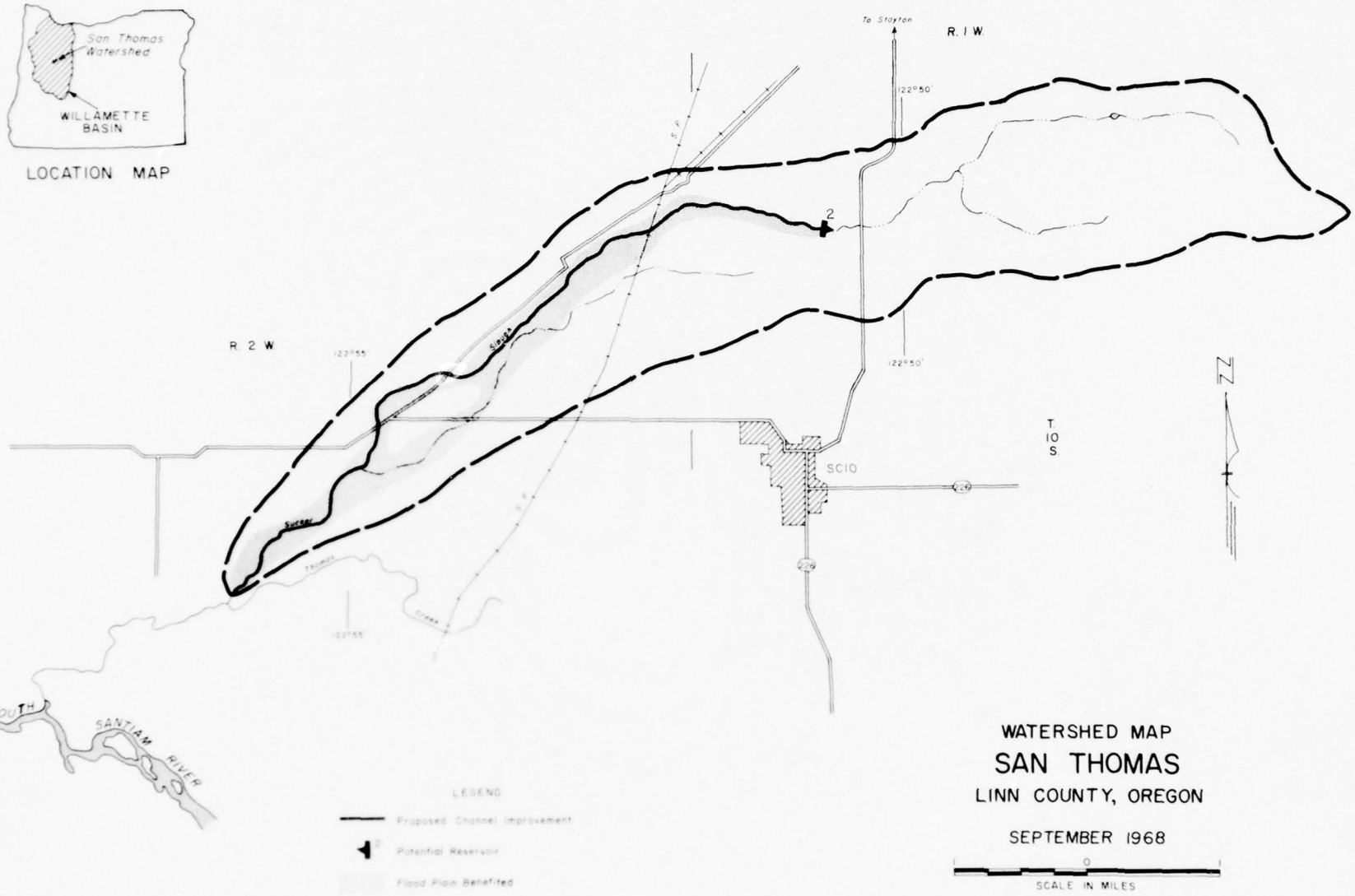
The project, as shown on the accompanying map, is located in the East Linn and Linn-Lane SWCD's. About three percent of the 29,320-acre area is in forest and woodland. In total, 205 farms are involved. There are about 700 acres of irrigated cropland, 14,800 acres of nonirrigated cropland, and 800 acres of pasture.

a. Proposed Structural Measures. - The project would consist of channel improvements for flood control and drainage and an irrigation distribution system.

(1) Channel improvements totaling about 42.5 miles in length would be made on Truax, Burkhart, and Cox Creeks and their tributaries. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in the existing or projected urban and built-up areas.

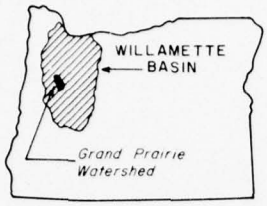
(2) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines. Irrigation water supply would be provided from natural flows in the South Santiam or from existing storage in upstream Federal reservoirs.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 5,700 acres to 800 acres and reduce flood damages by 96 percent. A full irrigation supply would be provided for 3,200 acres.



U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20859-L



LOCATION MAP



U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE. USDA-SCS PORTLAND, OREG. 1969



WATERSHED MAP

GRAND PRAIRIE

LINN COUNTY, OREGON

SEPTEMBER 1968

M7-N-20857

c. Project Costs. - The total project would cost in the order of $2.0 million, of which about $0.9 million would be for structural measures. Of the total cost, approximately $0.7 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $416 thousand and $67 thousand, respectively, for a B:C ratio of 6.2 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 5.2 to 1.

e. Current Status. - An application for assistance was submitted in 1964. The Grand Prairie Water Control District, formed in 1968 has legal authority to furnish assurances and participate. Sponsors currently include East Linn SWCD, Linn-Lane SWCD, Cities of Lebanon and Albany, Linn County, Grand Prairie Water Control District, and Oregon Association of SWCD's.

East Muddy Creek Watershed Project

The East Muddy Creek project is one of four in Santiam Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Linn-Lane SWCD. About 36 percent of the 97,190-acre area is in forest and woodland. In total, about 320 farms are involved. There are about 3,300 acres of irrigated cropland, 47,800 acres of nonirrigated cropland, and 6,400 acres of pasture.

a. Proposed Structural Measures. - The project would consist of rehabilitation of the existing McKenzie River diversion and pumping plant, and improvement of 20 miles of irrigation canals. Irrigation water would be supplied from existing rights.

b. Project Effects. - The proposed project would provide a full irrigation supply to an additional 7,000 acres.

c. Project Costs. - The total project would cost in the order of $1.7 million, of which about $0.5 million would be for structural

measures. Of the total cost, approximately $0.5 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $140 thousand and $35 thousand, respectively, for a B:C ratio of 4.0 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 3.4 to 1.

e. Current Status. - The East Muddy Creek Irrigation District is legally organized and has authority to furnish assurances and participate. Sponsors currently include Linn-Lane SWCD, East Muddy Creek Irrigation District, Upper Willamette RC&D and Oregon Association of SWCD's.

Walton Slough Watershed Project

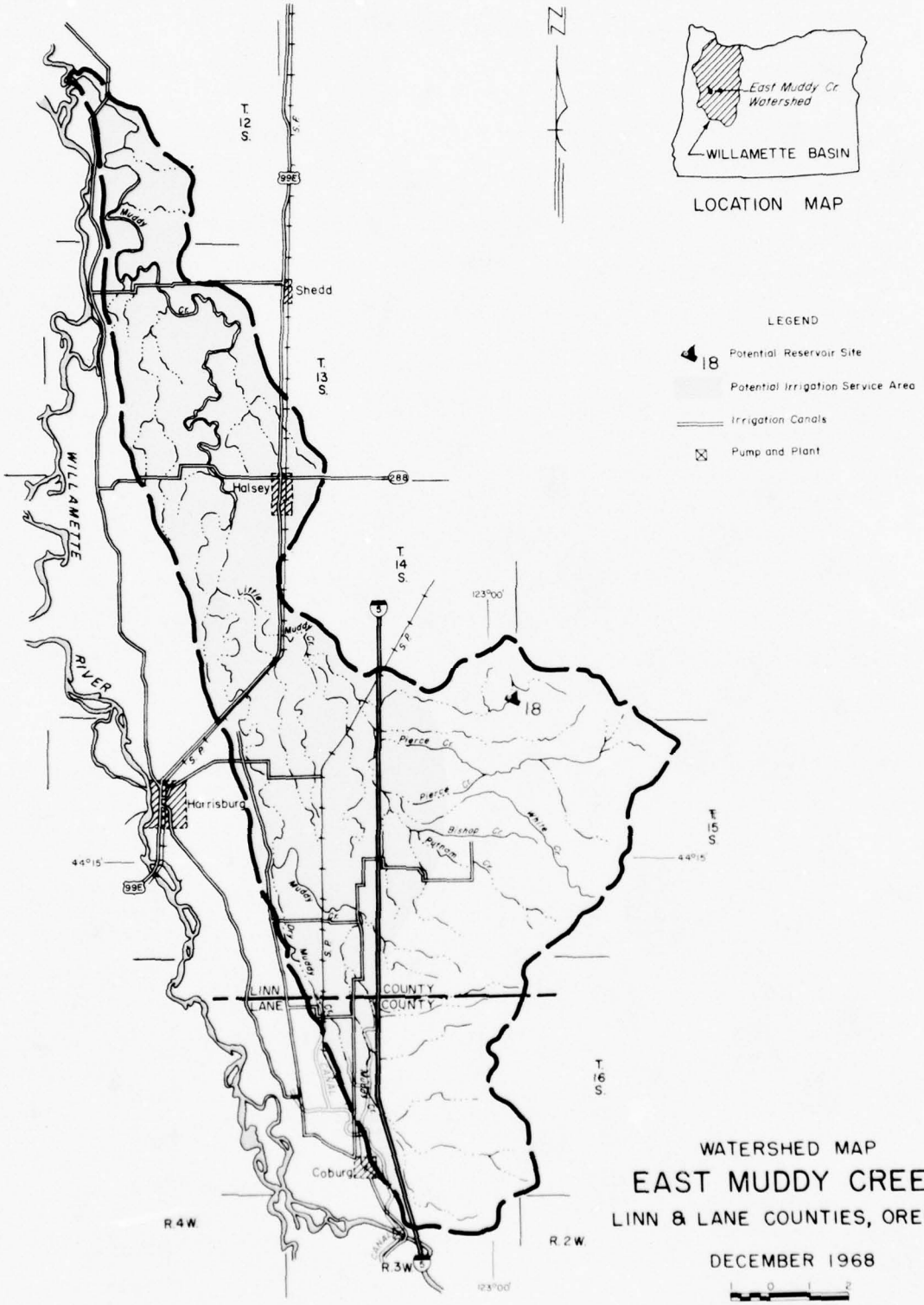
The Walton Slough project is one of four in Santiam Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Linn-Lane SWCD. About 39 percent of the 35,680-acre area is ir forest and woodland. In total, 140 farms are involved. There are about 1,200 acres of irrigated cropland, 18,400 acres of nonirrigated cropland, and 1,100 acres of pasture.

a. Proposed Structural Measures. - The project would consist of about 10.0 miles of channel improvements for flood control and drainage. Capacities would be provided for 3-year protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,450 acres to 290 acres and reduce flood damages by 80 percent.

c. Project Costs. - The total project would cost in the order of $542 thousand, of which about $310 thousand would be for structural measures. Of the total cost, approximately $285 thousand would be borne by PL 566 funds.



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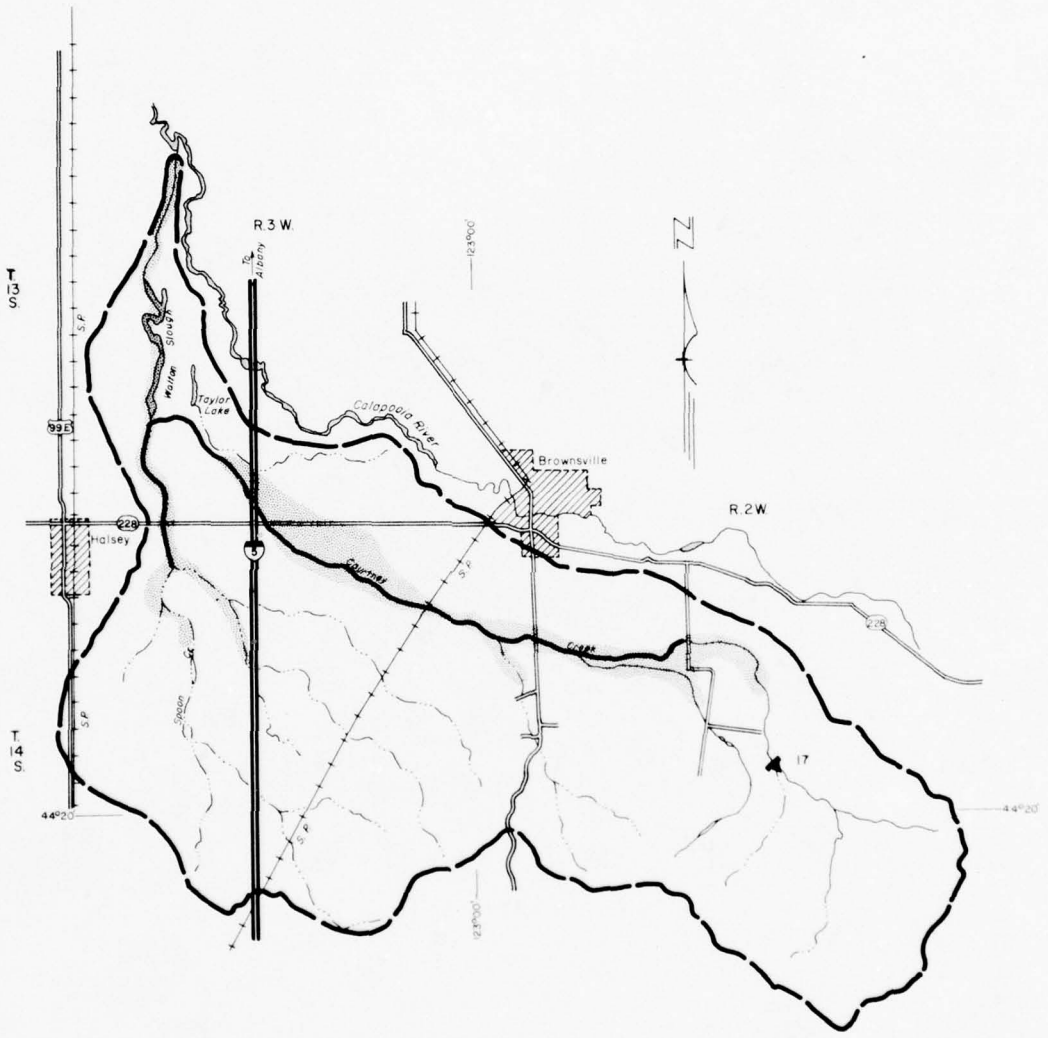
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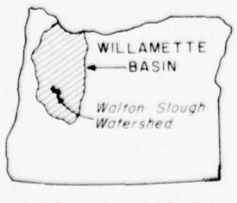
LEGEND

Proposed Channel Improvement

17 Potential Reservoir

Flood Plain Benefited





LOCATION MAP

WATERSHED MAP

WALTON SLOUGH

LINN COUNTY, OREGON

SEPTEMBER, 1968

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20858-L

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $60 thousand and $16 thousand, respectively, for a B:C ratio of 3.7 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 3.0 to 1.

e. Current Status. - Sponsors currently include Linn-Lane SWCD, Upper Willamette RC&D and Oregon Association of SWCD's.

Chehalem Creek Watershed Project

The Chehalem Creek project is one of nine in Coast Range Sub-basin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Yamhill County SWCD. About 50 percent of the 36,360-acre area is in forest and woodland. In total, 150 farms are involved. There are about 200 acres of irrigated cropland, 12,500 acres of nonirrigated cropland, and 3,300 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 4,700 acre-feet; channel improvements for flood control and drainage; and an irrigation distribution system.

(1) One reservoir would be at site No. 578 (SCS 102) in Section 33, Township 2 South, Range 3 West. Tributary drainage area would be about 1.7 square miles with an average annual yield of 2,400 acre-feet. A dam about 75 feet in height would raise the water surface to about elevation 380 feet, m.s.l., and create a reservoir with a storage capacity of about 2,400 acre-feet and a surface area of 80 acres.

(2) A second reservoir would be at site No. 581 (SCS 123) in Section 18, Township 3 South, Range 3 West. Tributary drainage area would be about 1.5 square miles with an average annual yield of 2,200 acre-feet. A dam about 45 feet in height would raise the water surface to about elevation 240 feet, m.s.l., and create a reservoir with a storage capacity of about 2,300 acre-feet and a surface area of 130 acres.

Both reservoirs would provide storage for reduction of flood damages and irrigation water supply to watershed lands.

(3) Channel improvements totaling about 9.0 miles in length would be made on Chehalem Creek and a tributary. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 490 acres to 90 acres and reduce flood damages by 65 percent. A full irrigation supply would be provided for 1,000 acres.

Additional storage in the reservoirs would provide in the order of 1,900 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made during preconstruction planning, in cooperation with project sponsors and concerned agencies.

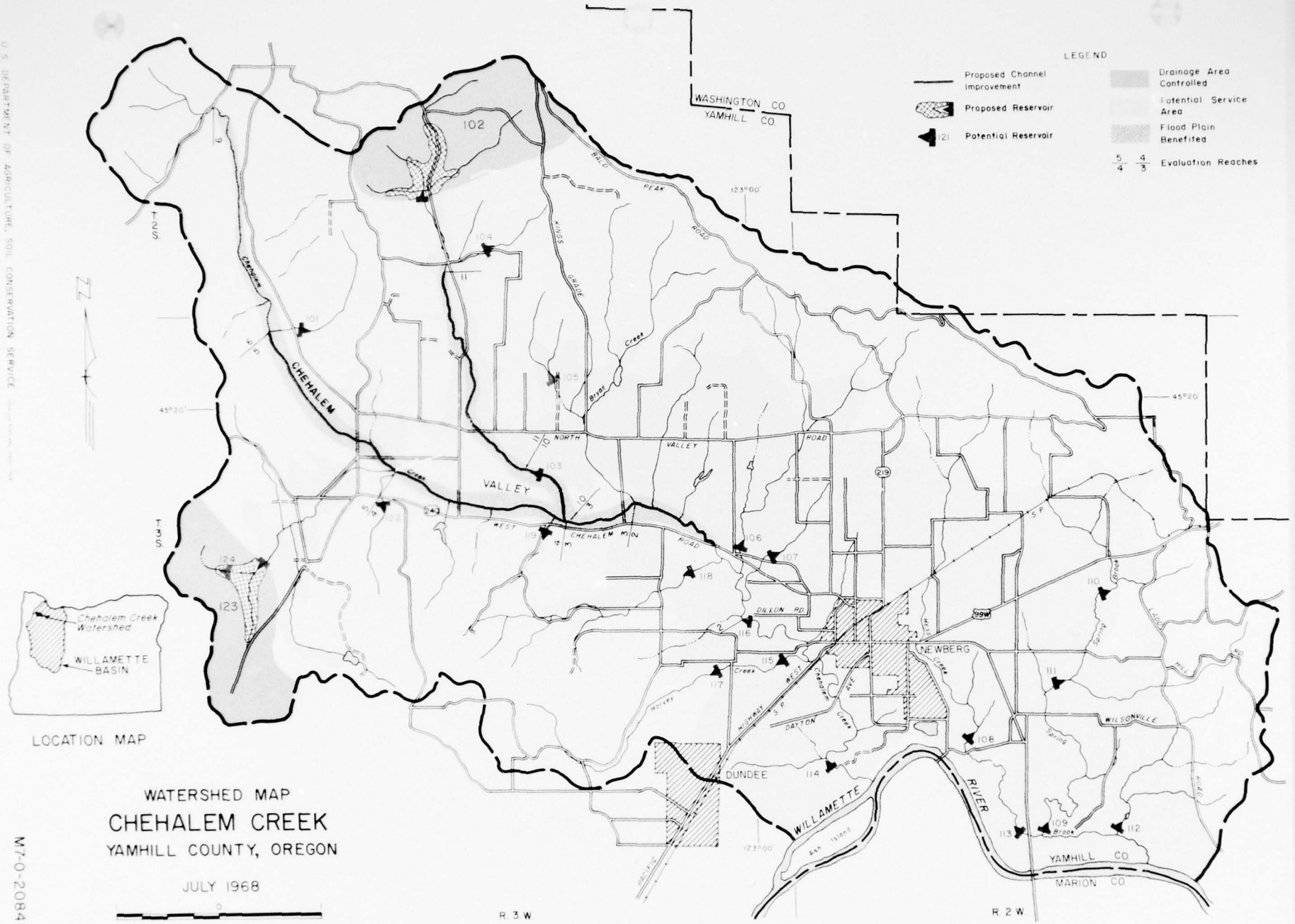
c. Project Costs. - The total project would cost in the order of $1.2 million, of which about $0.9 million would be for structural measures. Of the total cost, approximately $0.5 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $63 thousand and $40 thousand, respectively, for a B:C ratio of 1.6 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.2 to 1.

e. Current Status. - An application for assistance was submitted in 1956. Sponsors include Yamhill County SWCD, Chehalem Creek Project Steering Committee, Northwest Newberg Water Association, Chehalem Valley Water User's Association, Oregon Association of SWCD's and Newburg Rural Development Association.

Spring Valley Watershed Project

The Spring Valley project is one of nine in Coast Range Subbasin which were selected for early action. The following information


LEGEND
Proposed Channel Improvement
Proposed Reservoir
121 Potential Reservoir
Drainage Area Controlled
Potential Service Area
Flood Plain Benefited
5/4 4/3 Evaluation Reaches
WASHINGTON CO
YAMHILL CO.
CHEHALEM
VALLEY
NORTH VALLEY ROAD
CHEHALEM MTN ROAD
BALD PEAK ROAD
KINGS GRADE
Bryan Creek
Chehalem Creek
NEWBERG
DUNDEE
DILLON RD.
HIGHWAY 99W
WILSONVILLE
WILLAMETTE RIVER
YAMHILL CO
MARION CO
T 2 S.
T 3 S.
R 3 W
R 2 W
123°00'
45°20'
Chehalem Creek Watershed
WILLAMETTE BASIN
LOCATION MAP
WATERSHED MAP
CHEHALEM CREEK
YAMHILL COUNTY, OREGON
JULY 1968
SCALE IN MILES
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
M7-0-20849-N

is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Polk County SWCD. About 42 percent of the 13,160-acre area is in forest and woodland. In total, 110 farms are involved. There are about 700 acres of irrigated cropland, 5,900 acres of nonirrigated cropland, and 700 acres of pasture.

a. Proposed Structural Measures. - The project would consist of a reservoir, with a capacity of 4,800 acre-feet; and an irrigation distribution system.

(1) The reservoir would be at site No. 315 (SCS 31) in Section 26, Township 6 South, Range 4 West. Tributary drainage area would be about 3.5 square miles with an average annual yield of 4,700 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 235, m.s.l., and create a reservoir with a capacity of 4,800 acre-feet and a surface area of 200 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply to watershed lands; that service would be alternative to contracting for use of stored water diverted from existing upstream Federal storage, and local decision would be required prior to construction.

(2) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would provide a full irrigation supply for 1,700 acres.

c. Project Costs. - The total project would cost in the order of $1.2 million, of which about $0.9 million would be for structural measures. Of the total cost, approximately $0.4 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $51 thousand and $36 thousand, respectively, for a B:C ratio of 1.4 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.1 to 1.

e. Current Status. - Sponsors currently include Polk County SWCD and Oregon Association of SWCD's.

Deer Creek Watershed Project

The Deer Creek project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

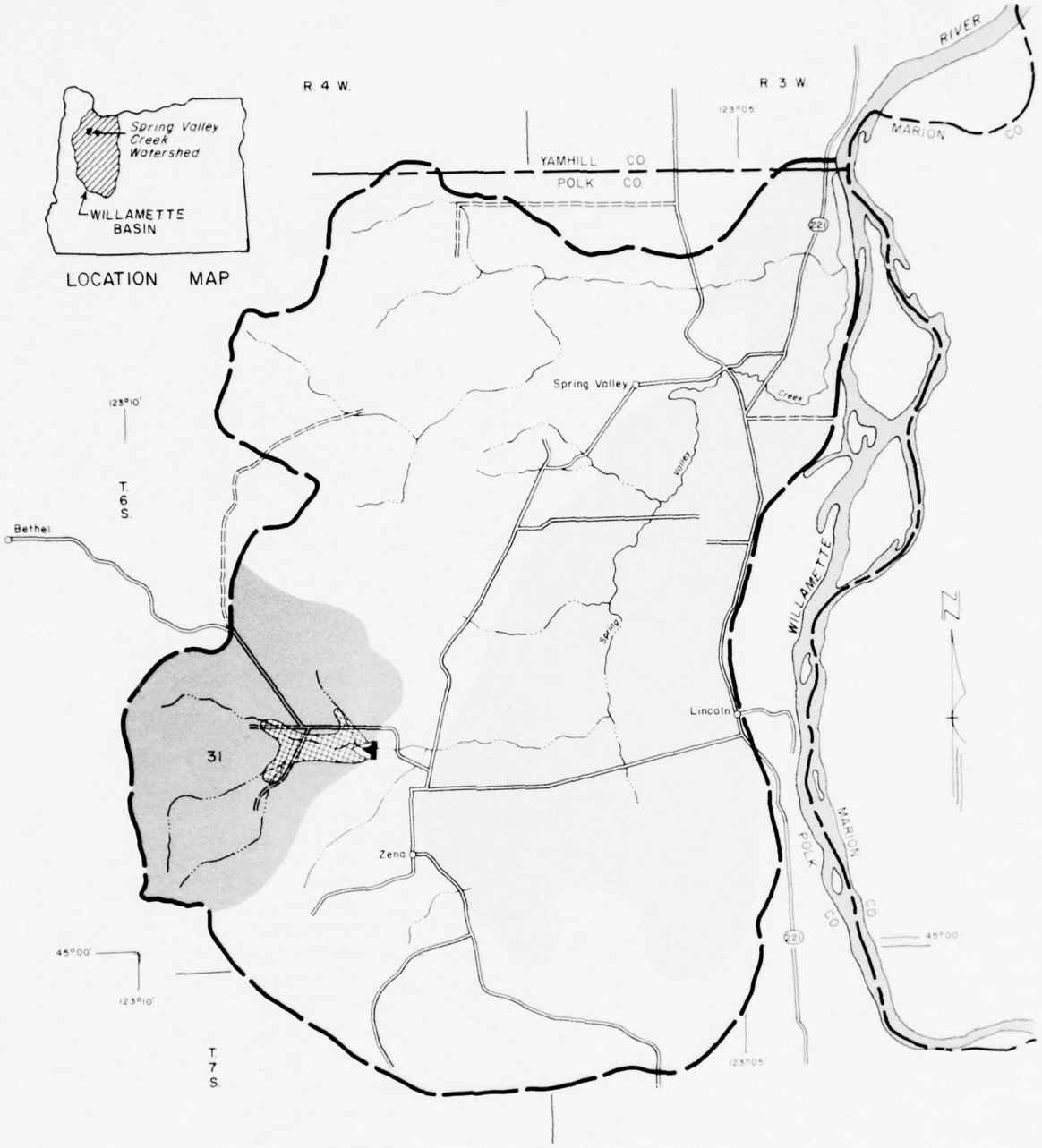
The project, as shown on the accompanying map, is located in the Yamhill County SWCD. About 61 percent of the 34,750-acre area is in forest and woodland. In total, 130 farms are involved. There are about 700 acres of irrigated cropland, 10,800 acres of nonirrigated cropland, and 1,400 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 36,400 acre-feet; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 269 (SCS 63) in Section 11, Township 5 South, Range 6 West. Tributary drainage area would be about 21.4 square miles with an average annual yield of 51,300 acre-feet. A dam about 80 feet in height would raise the water surface to about elevation 300 feet, m.s.l., and create a reservoir with a storage capacity of about 18,000 acre-feet and a surface area of 700 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply for watershed lands; that service would be alternative to supply from storage in other reservoirs being investigated by the Bureau of Reclamation, and local decision would be required prior to construction.

(2) A second reservoir would be at site No. 293 (SCS 13) Section 16, Township 5 South, Range 5 West. Tributary drainage area would be about 12.3 square miles with an average annual yield of 26,300 acre-feet. A dam about 80 feet in height would raise the water surface to about elevation 250 feet, m.s.l., and create a reservoir with a storage capacity of about 18,400 acre-feet and a surface area of 600 acres. In addition to incidental flood control, the reservoir would provide storage for water-based recreation and include basic recreation facilities to serve the estimated initial annual use.

(3) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.



LEGEND

- Proposed Reservoir
- Drainage Area Controlled
- Potential Irrigation Service Area

WATERSHED MAP

SPRING VALLEY CREEK

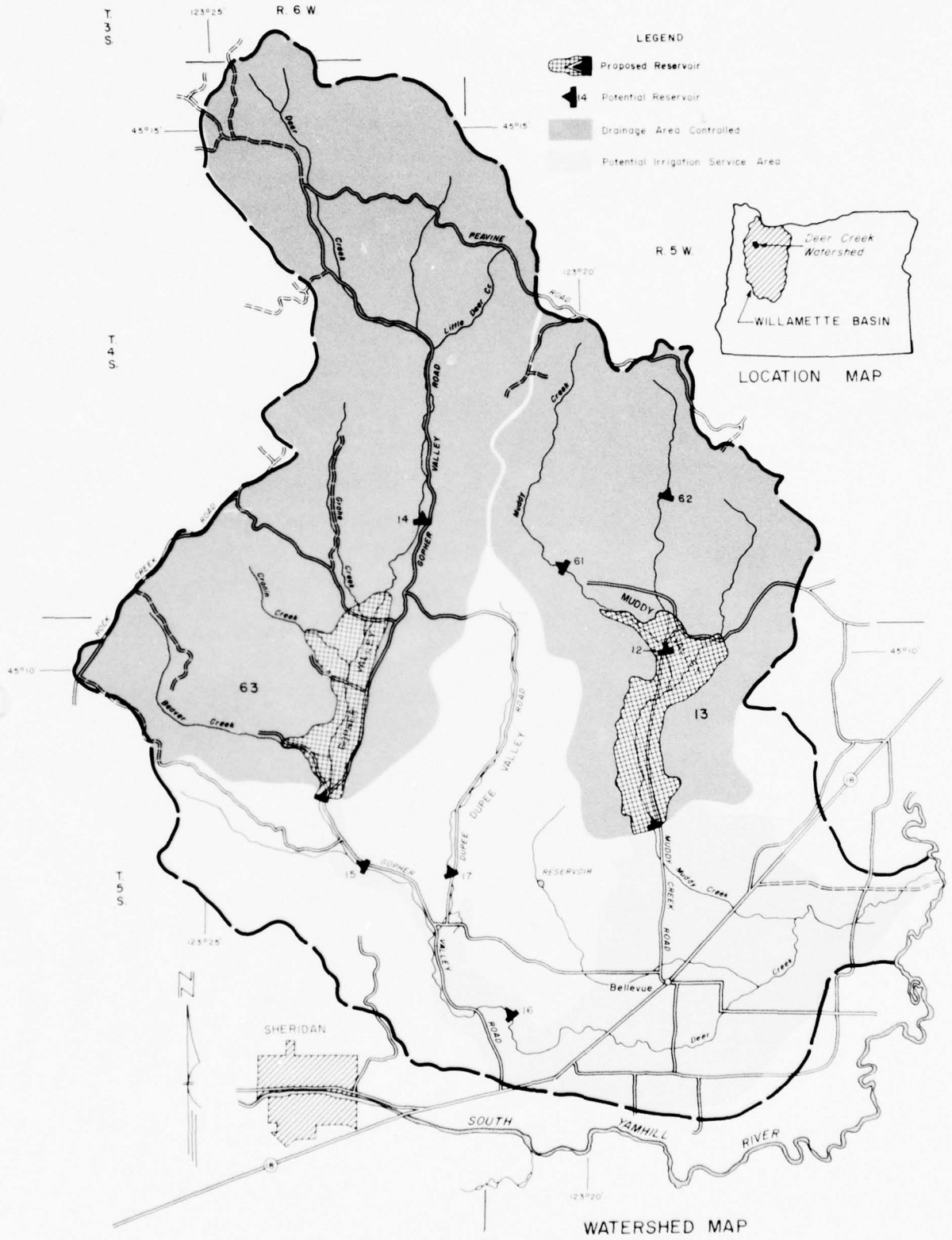
POLK COUNTY, OREGON

SEPTEMBER 1968

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20862-L



WATERSHED MAP

DEER CREEK

YAMHILL COUNTY, OREGON

SEPTEMBER 1968

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20863-L

b. Project Effects. - A full irrigation supply would be provided for 5,200 acres. Recreation facilities at site No. 293 would serve an initial use estimated at 100,000 visitor-days annually, including a reservoir fishery. The proposed project would also provide some reduction of flood damages.

Additional storage in the reservoirs would provide in the order of 3,900 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $4.3 million, of which about $3.6 million would be for structural measures. Of the total cost, approximately $1.9 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $214 thousand and $160 thousand, respectively, for a B:C ratio of 1.3 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent and no change in benefits the ratio would be approximately 1.0 to 1.

e. Current Status. - Sponsors currently include Yamhill County SWCD, South Yamhill River Steering Committee and Oregon Association of SWCD's.

Palmer Creek Watershed Project

The Palmer Creek project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Yamhill County SWCD. About 17 percent of the 21,380-acre area is in forest and woodland. In total, 150 farms are involved. There are about 2,000 acres of irrigated cropland, 12,300 acres of nonirrigated cropland, and 2,600 acres of pasture.

a. Proposed Structural Measures. - The project would consist of a reservoir, with a capacity of 11,600 acre-feet; an irrigation distribution system; and basic recreation facilities.

(1) The reservoir would be at site No. 300 (SCS 10) in Section 16, Township 4 South, Range 3 West. Tributary drainage area would be about 33.0 square miles with an average annual yield of 44,000 acre-feet. A dam about 70 feet in height would raise the water surface to about elevation 140 feet, m.s.l., and create a reservoir with a surface area of 690 acres. The reservoir would provide irrigation water supply to watershed lands and include basic recreation facilities to serve the estimated initial annual use.

(2) Irrigation facilities would consist of a distribution system utilizing new canals or pipelines.

b. Project Effects. - The proposed project would provide a full irrigation supply for 2,000 acres. Recreation facilities at the reservoir would serve an initial use estimated at 60,000 visitor-days annually, including a reservoir fishery.

c. Project Costs. - The total project would cost in the order of $2.1 million, of which about $1.6 million would be for structural measures. Of the total cost, approximately $0.9 million would be borne by PL 566 funds.

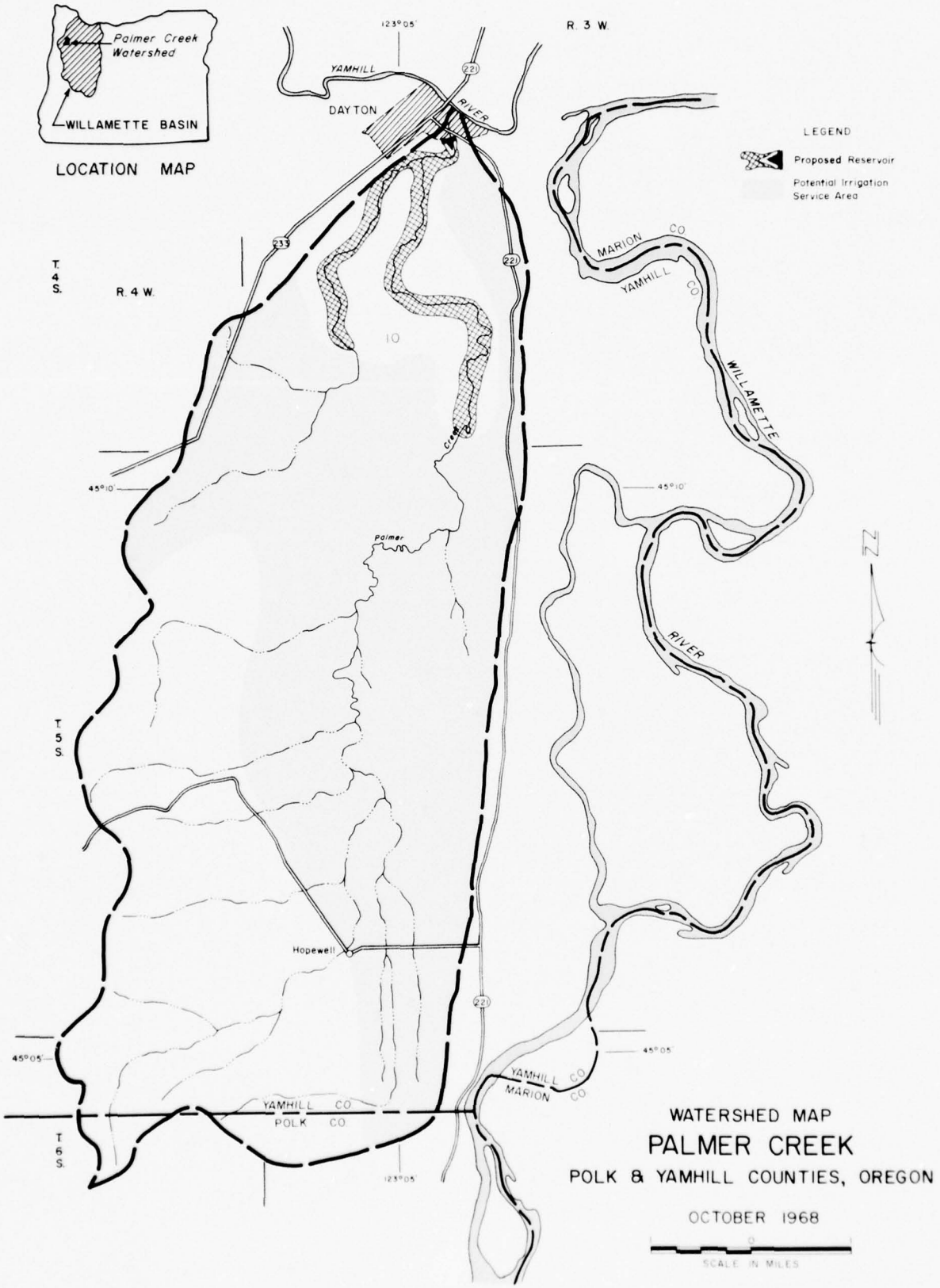
d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $140 thousand and $66 thousand, respectively, for a B:C ratio of 2.1 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.6 to 1.

e. Current Status. - Sponsors currently include Yamhill County SWCD, City of Dayton and Oregon Association of SWCD's.

Salt Creek Watershed Project

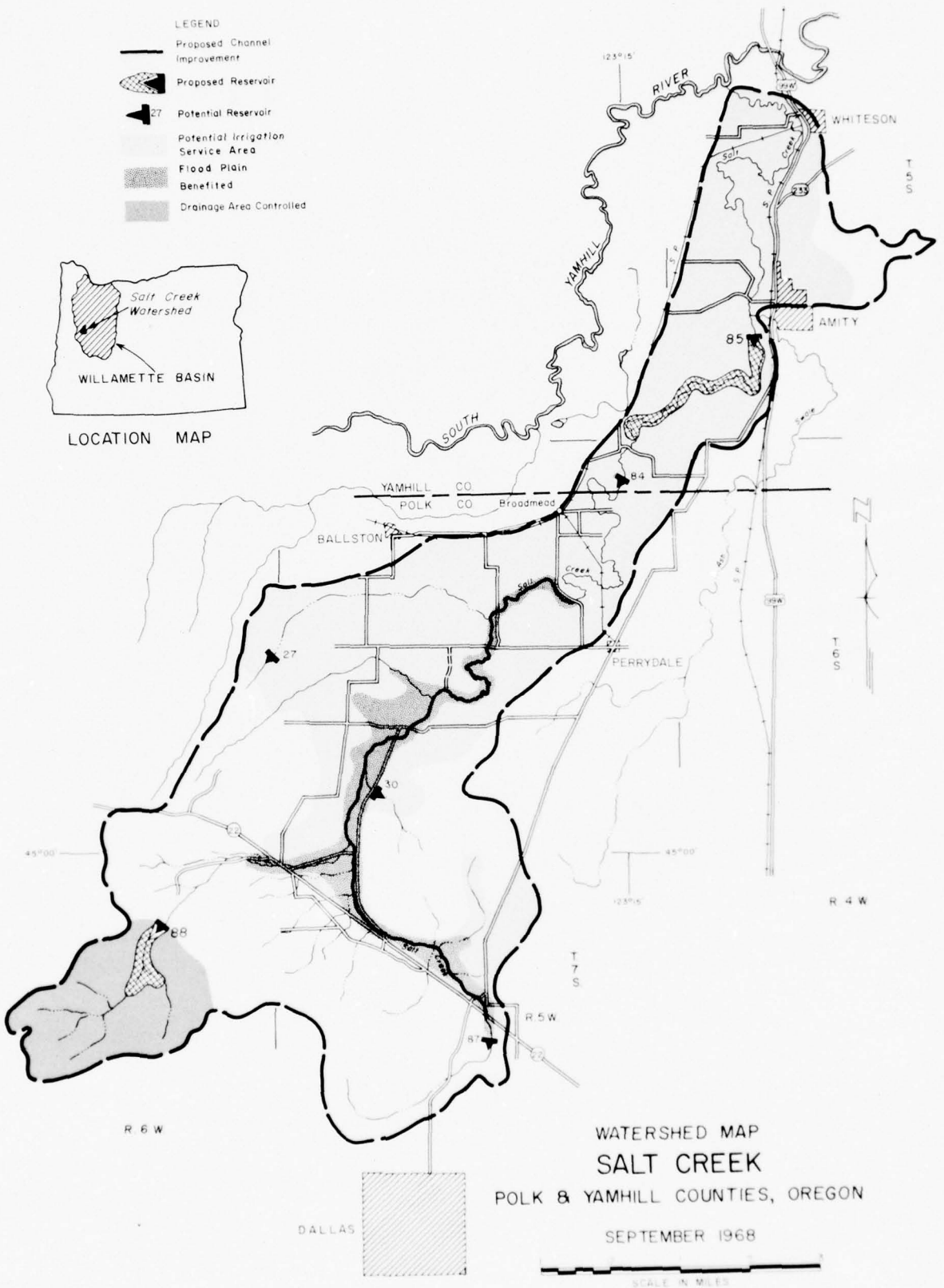
The Salt Creek project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Polk and Benton County SWCD's. About 24 percent of the 33,310-acre



U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20851-L



WATERSHED MAP

SALT CREEK

POLK & YAMHILL COUNTIES, OREGON

SEPTEMBER 1968

SCALE IN MILES

M7-0-2086I-L

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

area is in forest and woodland. In total, 135 farms are involved. There are about 100 acres of irrigated cropland, 21,500 acres of non-irrigated cropland, and 2,900 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 17,900 acre-feet; channel improvements for flood control and drainage; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 577 (SCS 88) in Section 11, Township 7 South, Range 6 West. Tributary drainage area would be about 4.4 square miles with an average annual yield of 9,700 acre-feet. A dam about 210 feet in height would raise the water surface to about elevation 710 feet, m.s.l., and create a reservoir with a storage capacity of about 9,500 acre-feet and a surface area of 140 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply for watershed lands and include basic recreation facilities to serve the estimated initial annual use.

(2) A second reservoir would be at site No. 558 (SCS 85) in Section 29, Township 5 South, Range 4 West. Tributary drainage area would be about 46.3 square miles with an average annual yield of 94,000 acre-feet. A dam about 40 feet in height would raise the water surface to about elevation 155 feet, m.s.l., and create a reservoir with a storage capacity of about 8,400 acre-feet and a surface area of 680 acres. The reservoir would provide irrigation water supply for watershed lands.

(3) Channel improvements totaling about 12.6 miles in length would be made on Salt Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 900 acres to 180 acres and reduce flood damages by 54 percent. Recreation facilities at site No. 577 would serve an initial use estimated at 24,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 4,400 acres.

Additional storage in the reservoirs would provide in the order of 1,000 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of 3.5 million, of which about $3.0 million would be for structural measures. Of the total cost, approximately $1.5 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $143 thousand and $123 thousand, respectively, for a B:C ratio of 1.2 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 0.9 to 1.

e. Current Status. - Sponsors currently include Polk County SWCD, Yamhill County SWCD, and Oregon Association of SWCD's.

Ash Creek Watershed Project

The Ash Creek project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Polk County SWCD. About 15 percent of the 22,000-acre area is in forest and woodland. In total, 100 farms are involved. There are about 200 acres of irrigated cropland, 14,200 acres of nonirrigated cropland, and 2,200 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 6,100 acre-feet; channel improvements for flood control and drainage; and basic recreation facilities.

(1) One reservoir would be at site No. 291 (SCS 34) in Section 14, Township 8 South, Range 5 West. Tributary drainage area would be about 2.4 square miles with an average annual yield of 4,600


R.6W.
R.5W.
R.4W.
RICKREALL
DALLAS
T.7 S.
T.8 S.
T.9 S.
33
34
Middle
North
Fork
South
Ash
Creek
MONMOUTH
INDEPENDENCE
HOFFMAN ROAD
TAL MADGE ROAD
VALLEY & SILETZ
WILLAMETTE RIVER
POLK CO.
MARION CO.
123°20'
123°15'
44°55'
44°50'
223
99W
99
Ash Creek Watershed
WILLAMETTE BASIN
LOCATION MAP
LEGEND
Proposed Channel Improvement
Proposed Reservoir
2 2/4 Evaluation Reaches
Drainage Area Controlled
Flood Plain Benefited
WATERSHED MAP
ASH CREEK
POLK COUNTY, OREGON
OCTOBER 1968
SCALE IN MILES
M7-0-20860-N
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

acre-feet. A dam about 40 feet in height would raise the water surface to about elevation 265 feet, m.s.l., and create a reservoir with a capacity of about 3,000 acre-feet and a surface area of 190 acres. The reservoir would provide storage for flood control and include basic recreation facilities to serve the estimated initial annual use.

(2) A second reservoir would be at site No. 296 (SCS 33) in Section 6, Township 8 South, Range 5 West. Tributary drainage area would be about 2.1 square miles with an average annual yield of 4,400 acre-feet. A dam about 50 feet in height would raise the water surface to about elevation 430 feet, m.s.l., and create a reservoir with a storage capacity of about 3,100 acre-feet and a surface area of 120 acres. The reservoir would provide storage for reduction of flood damages in the watershed.

(3) Channel improvements totaling about 11.2 miles in length would be made on North and Middle Forks of Ash Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 760 acres to 130 acres and reduce flood damages by 74 percent. Recreation facilities at site No. 291 would serve an initial use estimated at 24,000 visitor-days annually, including a reservoir fishery.

Additional storage in the reservoirs would provide in the order of 2,400 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $1.4 million, of which about $1.2 million would be for structural measures. Of the total cost, approximately $0.7 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $58 thousand and $47 thousand, respectively, for a B:C ratio of 1.2 to 1., at 3-1/4 percent. With

annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 0.9 to 1.

e. Current Status. - An application for assistance was submitted in 1967. The Ash Creek Water Control District, formed in 1954, has legal authority to furnish assurances and participate. Sponsors currently include Polk County SWCD; Polk County; Ash Creek Water Control District; Cities of Monmouth, Dallas, and Independence; and Oregon Association of SWCD's.

Little Luckiamute Watershed Project

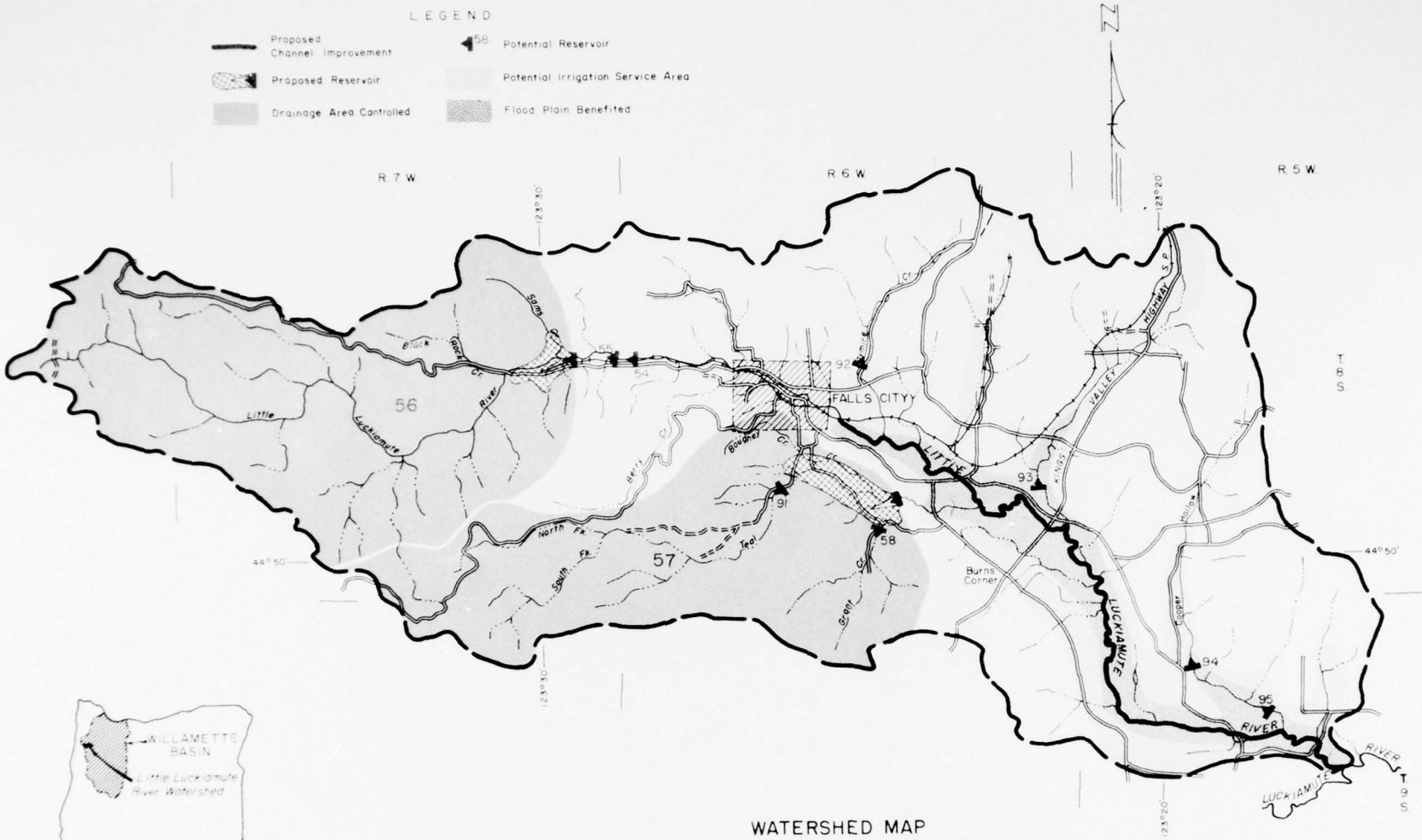
The Little Luckiamute project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Polk County SWCD. About 82 percent of the 52,640-acre area is in forest and woodland. In total, 50 farms are involved. There are about 1,100 acres of irrigated cropland, 4,200 acres of nonirrigated cropland, and 2,600 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 31,000 acre-feet; channel improvements for flood control; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 260 (SCS 56) in Section 13, Township 8 South, Range 7 West. Tributary drainage area would be about 20.4 square miles with an average annual yield of 65,200 acre-feet. A dam about 90 feet in height would raise the water surface to about elevation 740 feet, m.s.l., and create a reservoir with a storage capacity of about 6,000 acre-feet and a surface area of 160 acres. The reservoir would provide storage for reduction of flood damages in the watershed.

(2) A second reservoir would be at site No. 550 (SCS 57) in Section 27, Township 8 South, Range 6 West. Tributary drainage area would be about 13.0 square miles with an average annual yield of 31,200 acre-feet. A dam about 90 feet in height would raise the water surface to about elevation 360 feet, m.s.l., and create a reservoir with a



LOCATION MAP

WATERSHED MAP

LITTLE LUCKIAMUTE RIVER

POLK COUNTY, OREGON

JULY 1968

SCALE IN MILES

M7-0-207961

storage capacity of about 25,000 acre-feet and a surface area of 510 acres. In addition to incidental flood control, the reservoir would provide an irrigation water supply for watershed lands and include basic recreation facilities to serve the estimated initial annual use.

(3) Channel improvements totaling about 6.0 miles in length would be made on Little Luckiamute River. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system including existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,700 acres to 340 acres and reduce flood damages by 80 percent. Recreation facilities at site No. 550 would serve an initial use estimated at 80,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 4,000 acres.

Additional storage in the reservoirs would provide in the order of 5,000 acre-feet of storage space and stored water to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $4.1 million, of which about $3.6 million would be for structural measures. Of the total cost, approximately $1.9 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $213 thousand and $148 thousand, respectively, for a B:C ratio of 1.4 to 1 at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.1 to 1.

e. Current Status. - An application for assistance was submitted in 1967. The Little Luckiamute Water Control District, formed in 1968, has legal authority to furnish assurances and participate. Sponsors currently include Polk County SWCD, Little Luckiamute Water Control District, Polk County, City of Monmouth, and Oregon Association of SWCD's.

Soap Creek Watershed Project

The Soap Creek project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Benton and Polk County SWCD's. About 51 percent of the 33,720-acre area is in forest and woodland. In total, 75 farms are involved. There are less than 100 acres of irrigated cropland, 13,800 acres of nonirrigated cropland, and 1,400 acres of pasture.

a. Proposed Structural Measures. - The project would consist of a reservoir, with a capacity of 3,600 acre-feet; channel improvements for flood control and drainage; and an irrigation distribution system.

(1) The reservoir would be at site No. 316 (SCS 38) in Section 4, Township 10 South, Range 5 West. Tributary drainage area would be about 2.1 square miles with an average annual yield of 4,900 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 310 feet, m.s.l., and create a reservoir with a surface area of 210 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply for watershed lands.

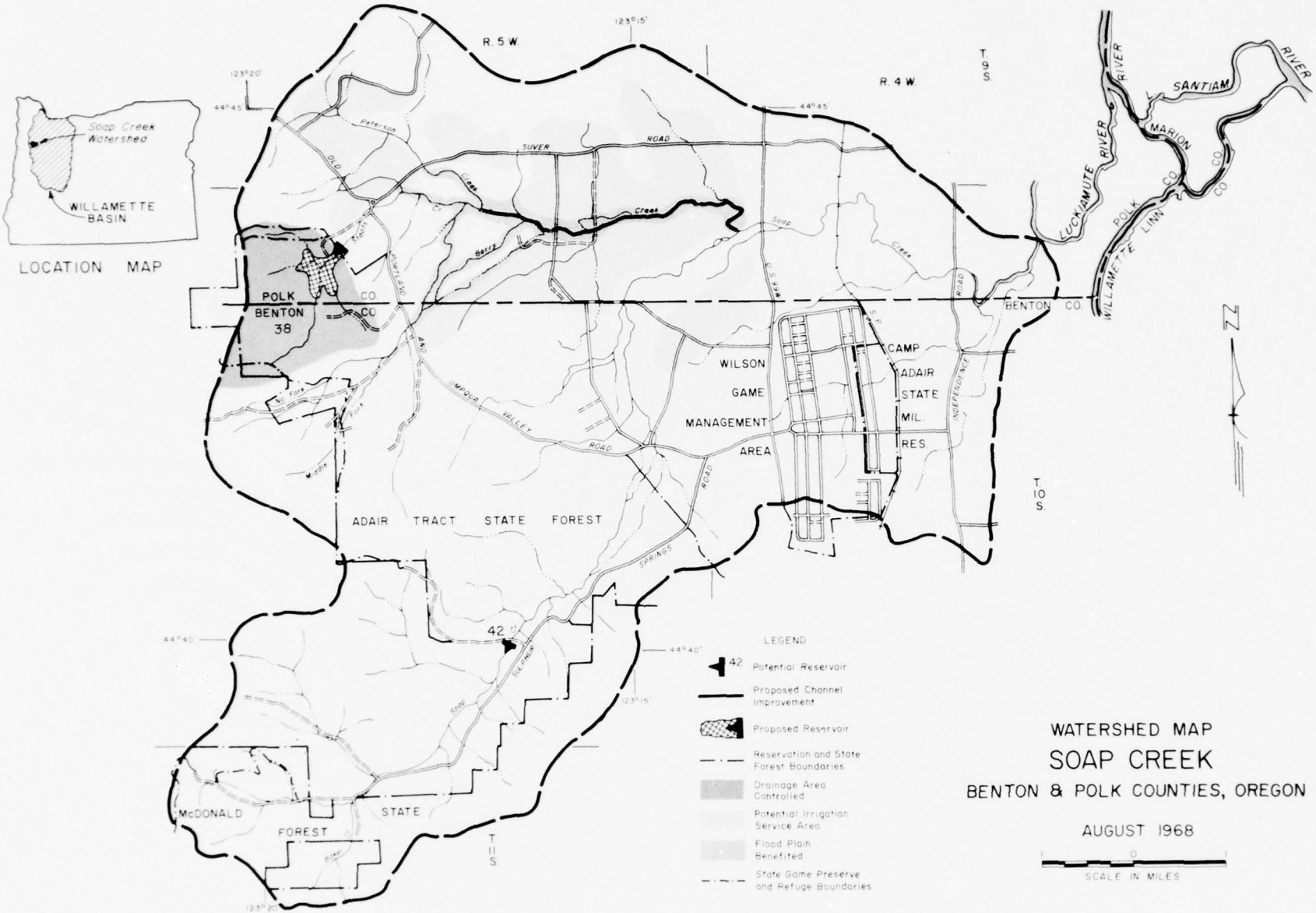
(2) Channel improvements totaling about 3.5 miles in length would be made on Staats Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(3) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 360 acres to 70 acres and reduce flood damages by 20 percent. A full irrigation supply would be provided for 1,200 acres.

c. Project Costs. - The total project would cost in the order of $1.1 million, of which about $0.8 million would be for structural measures. Of the total cost, approximately $0.5 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $82 thousand and $33 thousand



WATERSHED MAP

SOAP CREEK

BENTON & POLK COUNTIES, OREGON

AUGUST 1968

SCALE IN MILES

M7-0-20852-L

respectively, for a B:C ratio of 2.5 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.8 to 1.

e. Current Status. - An application for assistance was submitted in 1969. Sponsors currently include Polk County SWCD, Benton County SWCD, Polk County, and Oregon Association of SWCD's.

West Muddy Creek Watershed Project

The West Muddy Creek project is one of nine in Coast Range Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Benton County SWCD. About 56 percent of the 79,980-acre area is in forest and woodland. In total, 200 farms are involved. There are about 1,600 acres of irrigated cropland, 24,800 acres of nonirrigated cropland, and 2,500 acres of pasture.

a. Proposed Structural Measures. - The project would consist of three reservoirs, with a combined capacity of 32,200 acre-feet; channel improvements for flood control and drainage; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 259 (SCS 49) in Section 11, Township 13 South, Range 6 West. Tributary drainage area would be about 10.7 square miles with an average annual yield of 28,500 acre-feet. A dam about 90 feet in height would raise the water surface to about elevation 595 feet, m.s.l., and create a reservoir with a storage capacity of about 13,000 acre-feet and a surface area of 340 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply for watershed lands.

(2) The second reservoir would be at site No. 310 (SCS 50) in Section 2, Township 14 South, Range 6 West. Tributary drainage area would be about 6.1 square miles with an average annual yield of 15,600 acre-feet. A dam about 80 feet in height would raise the water surface to about elevation 430 feet, m.s.l., and create a reservoir with a storage capacity of about 9,600 acre-feet and a surface area of 320 acres. In addition to incidental flood control, this reservoir would provide

storage for irrigation water supply.

(3) A third reservoir would be at site No. 299 (SCS 51) in Section 14, Township 14 South, Range 6 West. Tributary drainage area would be about 13.0 square miles with an average annual yield of 34,600 acre-feet. A dam about 80 feet in height would raise the water surface to about elevation 400 feet, m.s.l., and create a reservoir with a storage capacity of about 9,600 acre-feet and a surface area of 260 acres. The reservoir would provide storage for reduction of flood damages in the watershed and include basic recreation facilities to serve the estimated initial annual use.

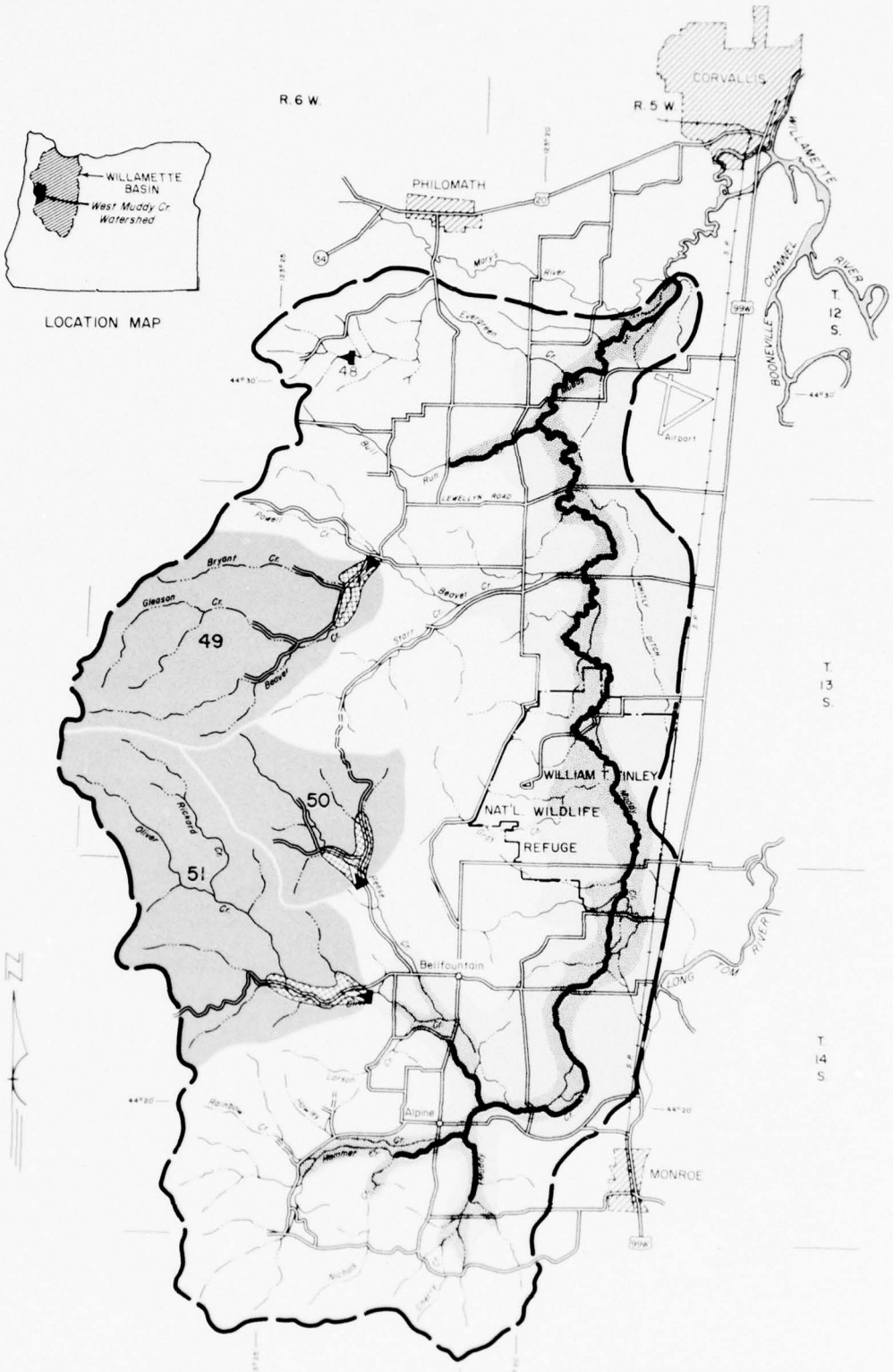
(4) Channel improvements totaling about 31.2 miles in length would be made on West Muddy, Oliver, Hammer, and Bull Run Creeks, Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas. Capacities in W. L. Finley Wildlife Refuge will be determined, prior to construction, in cooperation with project sponsors and concerned agencies.

(5) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines. Irrigation service would be alternative to contracting for use of stored water diverted from existing storage in Fern Ridge Reservoir, and local decision would be required prior to construction.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 4,570 acres to 920 acres and reduce flood damages by 80 percent. Recreation facilities at site No. 299 would serve an initial use estimated at 50,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 7,600 acres.

c. Project Costs. - The total project would cost in the order of $5.6 million, of which about $4.5 million would be for structural measures. Of the total cost, approximately $2.5 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $291 thousand and $197 thousand, respectively, for a B:C ratio of 1.5 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would



WATERSHED MAP

WEST MUDDY CREEK

BENTON COUNTY, OREGON

MAY 1968

SCALE IN MILES

M7-0-20716-L

be approximately 1.1 to 1.

e. Current Status. - An application for assistance was submitted in 1968. Sponsors currently include Benton County SWCD, Benton County, Upper Willamette RC&D, and Oregon Association of SWCD's.

Butte Creek Watershed Project

The Butte Creek project is one of three in Pudding Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Mt. Angel and South Clackamas SWCD's. About 66 percent of the 44,210-acre area is in forest and woodland. In total, 240 farms are involved. There are about 4,000 acres of irrigated cropland, 8,000 acres of non-irrigated cropland, and 1,600 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 21,300 acre-feet; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 337 (SCS 46) in Section 20, Township 6 South, Range 2 East. Tributary drainage area would be about 3.3 square miles with an average annual yield of 8,100 acre-feet. A dam about 90 feet in height would raise the water surface to about elevation 1,090 feet, m.s.l., and create a reservoir with a storage capacity of about 5,700 acre-feet and a surface area of 190 acres. In addition to incidental flood control, the reservoir would provide storage for water-based recreation and include basic facilities to serve the estimated initial annual recreation use.

(2) A second reservoir would be at site No. 586 (SCS 49) in Section 4, Township 7 South, Range 2 East. Tributary drainage area would be about 7.1 square miles with an average annual yield of 19,000 acre-feet. A dam about 100 feet in height would raise the water surface to about elevation 1,175 feet, m.s.l., and create a reservoir with a storage capacity of about 15,600 acre-feet and a surface area of 300 acres. In addition to incidental flood control, the reservoir would provide irrigation water supply for watershed lands.

(3) Irrigation facilities would consist of a distribution system including existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would provide a full irrigation supply for 5,200 acres. Recreation facilities at site No. 337 would serve an initial use estimated at 35,000 visitor-days annually, including a reservoir fishery.

Additional storage in the reservoirs would provide in the order of 1,500 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $3.7 million, of which about $2.9 million would be for structural measures. Of the total cost, approximately $1.5 million would be borne by PL 566 funds.

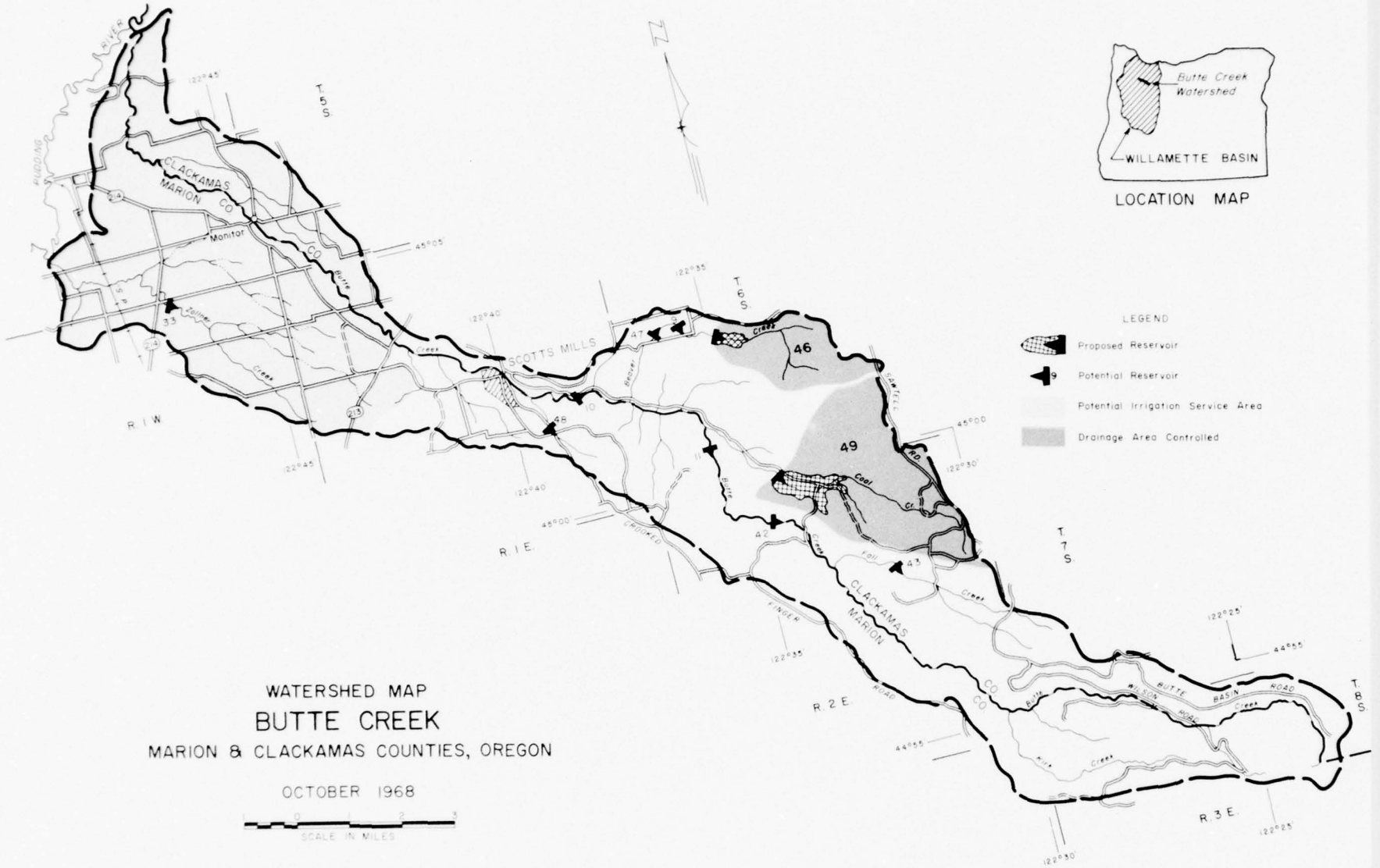
d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $281 thousand and $128 thousand, respectively, for a B:C ratio of 2.2 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.7 to 1.

e. Current Status. - An application for assistance was submitted in 1961. Sponsors currently include Mt. Angel SWCD, Silver Creek SWCD, South Clackamas SWCD, City of Woodburn, City of Mt. Angel, and Oregon Association of SWCD's.

Drift-Pudding Watershed Project

The Drift-Pudding project is one of three in Pudding Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Silver Creek and Mt. Angel SWCD's. About 32 percent of the 53,290-acre area is in forest and woodland. In total, 450 farms are involved. There are about 3,500 acres of irrigated cropland, 23,100 acres of non-



WATERSHED MAP

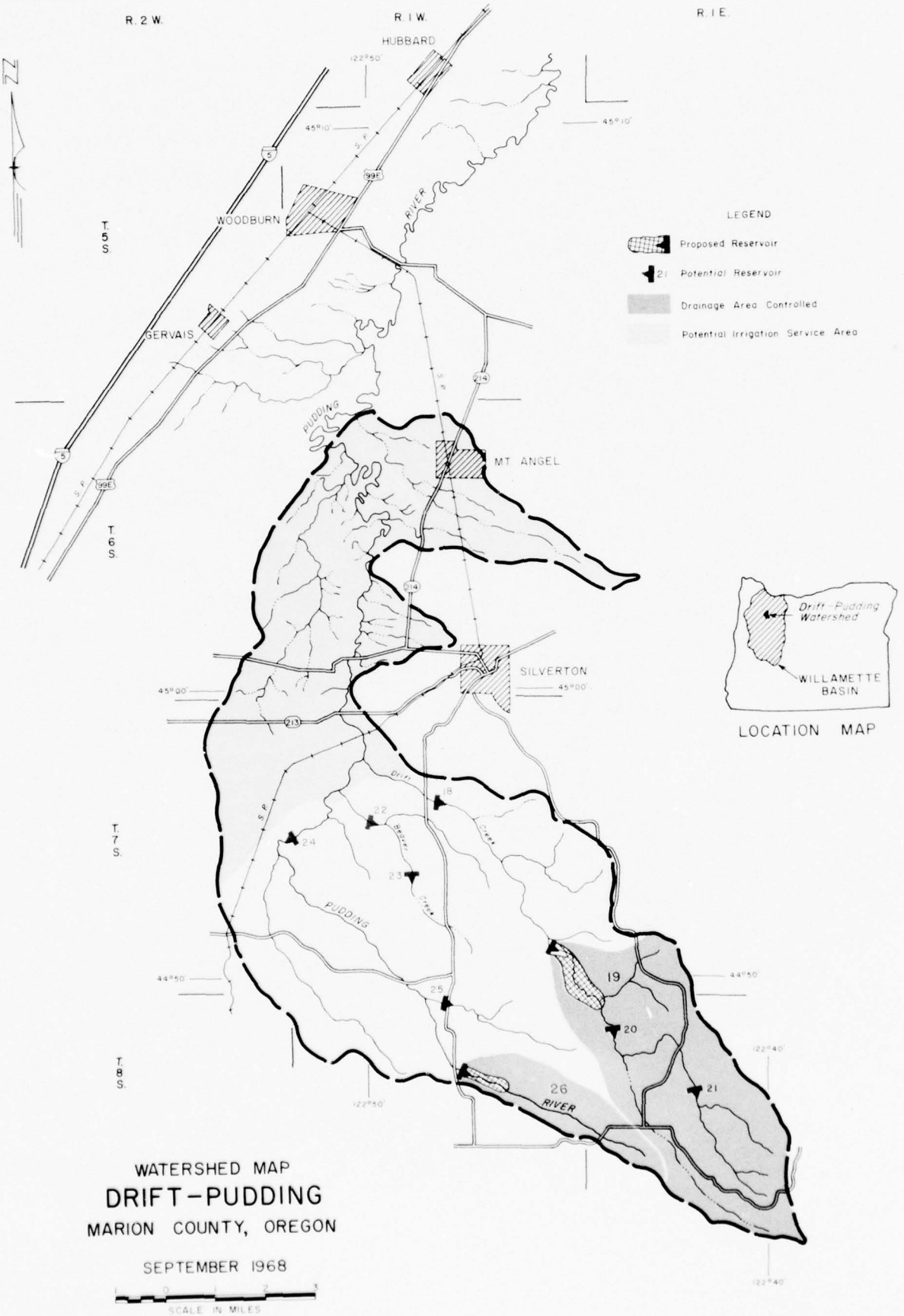
BUTTE CREEK

MARION & CLACKAMAS COUNTIES, OREGON

OCTOBER 1968

SCALE IN MILES

M7-0-20867-1



U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20864-L

irrigated cropland, and 4,800 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 14,200 acre-feet; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 350 (SCS 26) in Section 10, Township 8 South, Range 1 West. Tributary drainage area would be about 4.5 square miles with an average annual yield of 10,200 acre-feet. A dam about 50 feet in height would raise the water surface to about elevation 670 feet, m.s.l., and create a reservoir with a storage capacity of about 5,200 acre-feet and a surface area of 260 acres. The reservoir would provide irrigation water supply for watershed lands and include basic facilities to serve the estimated initial annual recreation use.

(2) A second reservoir would be at site No. 410 (SCS 19) in Section 36, Township 7 South, Range 1 West. Tributary drainage area would be about 15.5 square miles with an average annual yield of 37,100 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 640 feet, m.s.l., and create a reservoir with a storage capacity of about 9,000 acre-feet and a surface area of 310 acres. In addition to incidental flood control, the reservoir would also provide irrigation water supply to watershed lands.

(3) Irrigation facilities would consist of a distribution system utilizing existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would provide a full irrigation supply for 2,300 acres. Recreation facilities at site No. 350 would serve an initial use estimated at 40,000 visitor-days annually, including a reservoir fishery.

Additional storage in the reservoirs would provide in the order of 2,900 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $2.2 million, of which about $1.6 million would be for structural

measures. Of the total cost, approximately $0.8 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $138 thousand and $65 thousand, respectively, for a B:C ratio of 2.1 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.6 to 1.

e. Current Status. - An application for assistance was submitted in 1961. Sponsors currently include Silver Creek SWCD, Santiam SWCD, Drift Creek Steering Committee, and Oregon Association of SWCD's.

Mill Creek Watershed Project

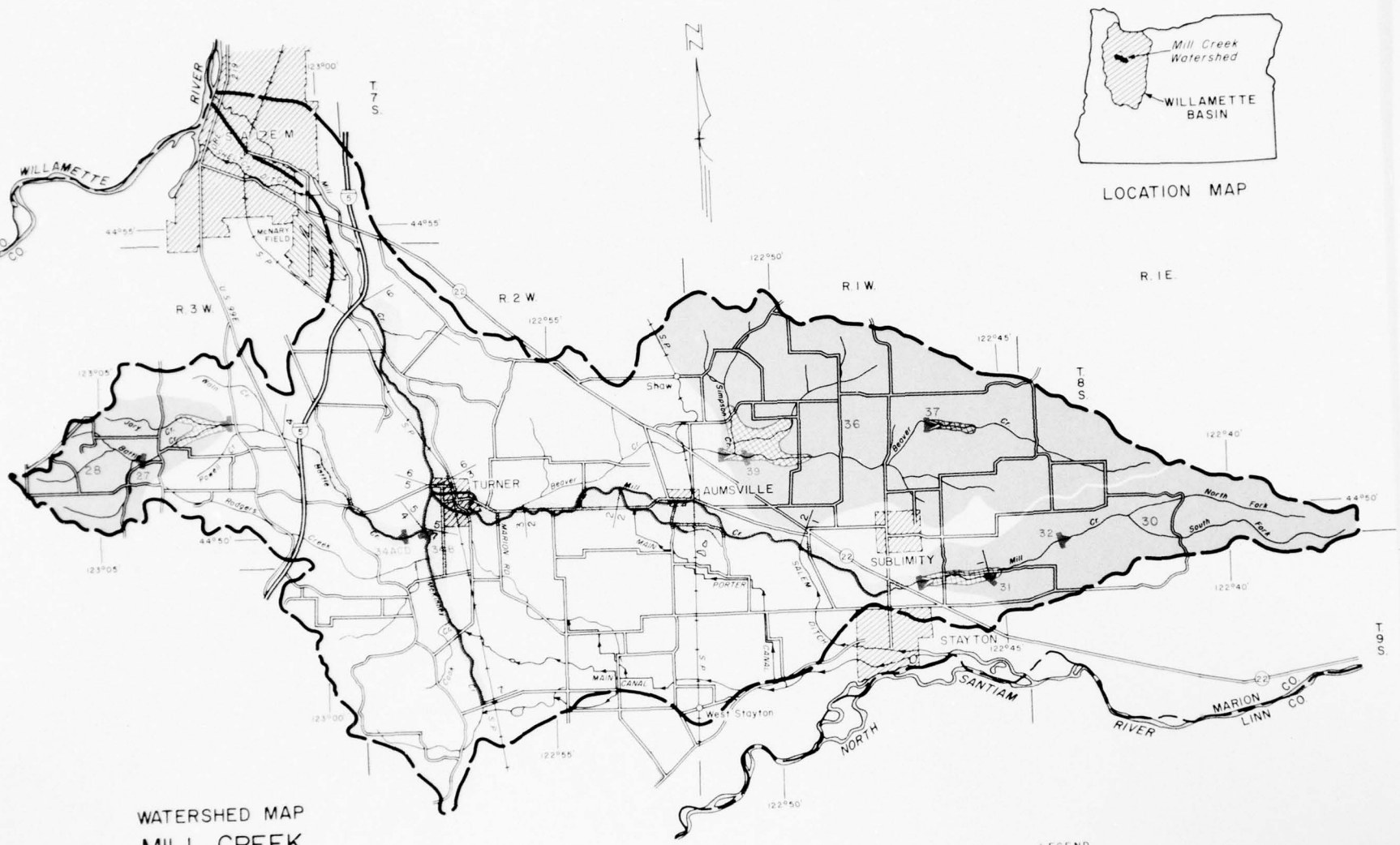
The Mill Creek project is one of three in Pudding Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Silver Creek and Santiam SWCD's. About 19 percent of the 64,130-acre area is in forest and woodland. In total, 675 farms are involved. There are about 4,300 acres of irrigated cropland, 36,100 acres of nonirrigated cropland, and 600 acres of pasture.

a. Proposed Structural Measures. - The project would consist of three reservoirs, with a combined capacity of 29,800 acre-feet; channel improvements for flood control and drainage; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 367 (SCS 30) in Section 2, Township 9 South, Range 1 West. Tributary drainage area would be about 10.5 square miles with an average annual yield of 26,300 acre-feet. A dam about 50 feet in height would raise the water surface to about elevation 495 feet, m.s.l., and create a reservoir with a storage capacity of about 5,900 acre-feet and a surface area of 250 acres. The reservoir would provide storage for reduction of flood damages in the watershed.

(2) A second reservoir would be at site No. 407 (SCS 36) in Section 30, Township 8 South, Range 1 West. Tributary drainage area would be about 21.1 square miles with an average annual yield of 51,700



WATERSHED MAP

MILL CREEK

MARION COUNTY, OREGON

AUGUST 1968

SCALE IN MILES

LEGEND

- Proposed Channel Improvement
- Proposed Reservoir
- Potential Reservoir
- Drainage Area Controlled
- Flood Plain Benefited
- 3/4 4/5 Evaluation Reaches

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M7-0-20850-L

acre-feet. A dam about 50 feet in height would raise the water surface to about elevation 400 feet, m.s.l., and create a reservoir with a storage capacity of about 21,200 acre-feet and a surface area of 1,000 acres. This reservoir would also provide storage for reduction of flood damages and include basic facilities to serve the estimated initial annual recreation use.

(3) A third reservoir would be at site No. 358 (SCS 28) in Section 22, Township 8 South, Range 3 West. Tributary drainage area would be about 5.5 square miles with an average annual yield of 9,400 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 455 feet, m.s.l., and create a reservoir with a storage capacity of about 2,700 acre-feet and a surface area of 100 acres. In addition to incidental flood control, the reservoir would provide for water-based recreation and include basic facilities to serve the estimated initial annual recreation use.

(4) Channel improvements totaling about 21.5 miles in length would be made on Mill, Battle, Porter, and McKinney Creeks and on Turner Diversion. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,810 acres to 350 acres and reduce flood damages by 84 percent. Recreation facilities would serve an initial use estimated at 200,000 visitor-days annually, including a reservoir fishery.

Additional storage in the reservoirs would provide in the order of 4,150 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $5.0 million, of which about $4.4 million would be for structural measures. Of the total cost, approximately $2.4 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $324 thousand and $167 thousand, respectively, for a B:C ratio of 1.9 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 1.5 to 1.

e. Current Status. - An application for assistance was submitted in 1961. The Santiam and Beaver Creek Water Control Districts have legal authority to furnish assurances and participate. Sponsors currently include Santiam SWCD; Silver Creek SWCD; Beaver Creek Water Control District; Santiam Water Control District; Cities of Stayton, Aumsville, Turner, and Salem; and Oregon Association of SWCD's.

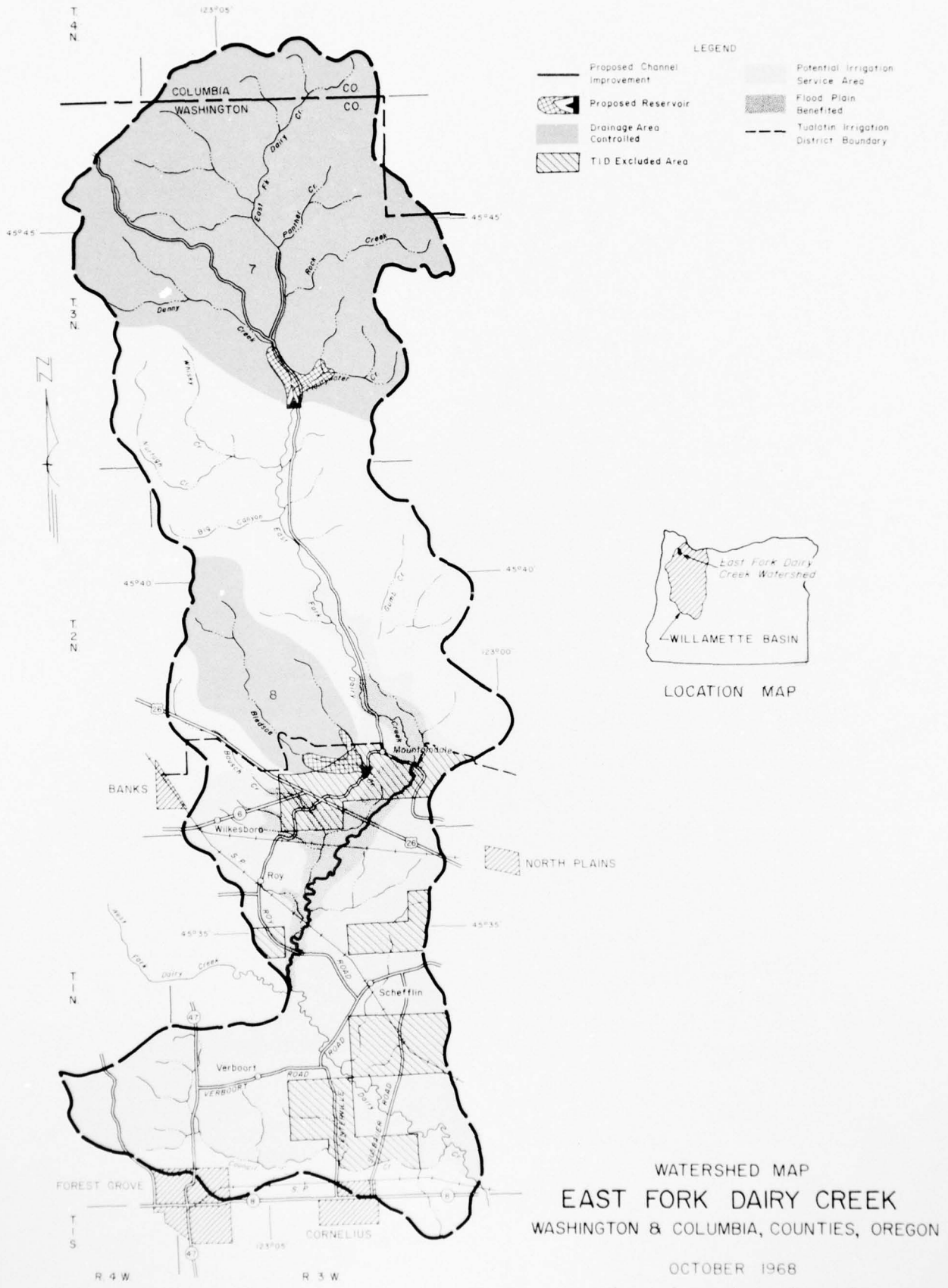
East Fork Dairy Creek Watershed Project

The East Fork Dairy Creek project is one of two in Tualatin Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, is located in the Washington County SWCD. About 53 percent of the 51,940-acre area is in forest and woodland. In total, 380 farms are involved. There are about 3,200 acres of irrigated cropland, 17,600 acres of nonirrigated cropland, and 1,000 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 18,000 acre-feet; channel improvements for flood control and drainage; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 440 (SCS 7) in Section 28, Township 3 North, Range 3 West. Tributary drainage area would be about 24.9 square miles with an average annual yield of 47,800 acre-feet. A dam about 150 feet in height would raise the water surface to about elevation 550 feet, m.s.l., and create a reservoir with a storage capacity of about 10,000 acre-feet and a surface area of 180 acres. In addition to incidental flood control, the reservoir would provide storage for irrigation water supply; that service would be alternative to storage in other reservoirs being investigated by the Bureau of Reclamation, and local decision would be required prior to construction.


LEGEND
Proposed Channel Improvement
Proposed Reservoir
Drainage Area Controlled
TID Excluded Area
Potential Irrigation Service Area
Flood Plain Benefited
Tualatin Irrigation District Boundary
T 4 N
T 3 N
T 2 N
T 1 N
T 1 S
R 4 W
R 3 W
123°05'
45°45'
45°40'
123°00'
45°35'
COLUMBIA CO.
WASHINGTON CO.
East Fk Dairy Cr.
Panhay Cr.
Rock Creek
Denny Creek
Burlington Cr.
Big Canyon
Fork
Gunn Cr.
Dairy Creek
Bradbury
Mountaindale
Rock Cr.
BANKS
Wilkesboro
Roy
NORTH PLAINS
West Fork Dairy Creek
Schefflin
Verboort
Verboort Road
Scheffler Road
Cemetery
FOREST GROVE
CORNELIUS
7
8
East Fork Dairy Creek Watershed
WILLAMETTE BASIN
LOCATION MAP
WATERSHED MAP
EAST FORK DAIRY CREEK
WASHINGTON & COLUMBIA, COUNTIES, OREGON
OCTOBER 1968
SCALE IN MILES
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE
M7-0-20865-L

(2) A second reservoir would be at site No. 438 (SCS 8) in Section 27, Township 2 North, Range 3 West. Tributary drainage area would be about 5.2 square miles with an average annual yield of 9,400 acre-feet. A dam about 40 feet in height would raise the water surface to about elevation 220 feet, m.s.l., and create a reservoir with a capacity of 8,000 acre-feet and a surface area of 370 acres. In addition to incidental flood control, the reservoir would provide storage for water-based recreation and include basic facilities to serve the estimated initial annual recreation use.

(3) Channel improvements totaling about 6.0 miles in length would be made on East Fork of Dairy Creek. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system including existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 1,200 acres to 240 acres and reduce flood damages by 80 percent. Recreation facilities at site No. 438 would serve an initial use estimated at 60,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 2,500 acres.

Additional storage in the reservoirs would provide in the order of 5,500 acre-feet of storage space and stored water, to the extent that benefits would be equal to costs, to serve uses such as fish and wildlife, municipal and industrial water supply, water quality control, etc. Decisions as to extent and use of that space would be made, during preconstruction planning, in cooperation with project sponsors and concerned agencies.

c. Project Costs. - The total project would cost in the order of $3.4 million, of which about $3.0 million would be for structural measures. Of the total cost, approximately $1.6 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $160 thousand and $121 thousand, respectively, for a B:C ratio of 1.3 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would

be approximately 1 to 1.

e. Current Status. - Sponsors currently include Washington County SWCD, Buxton Community Club, Sunset Chamber of Commerce, Dairy Creek Farm Bureau, Manning Social Club, and Oregon Association of SWCD's.

West Fork Dairy Creek Watershed Project

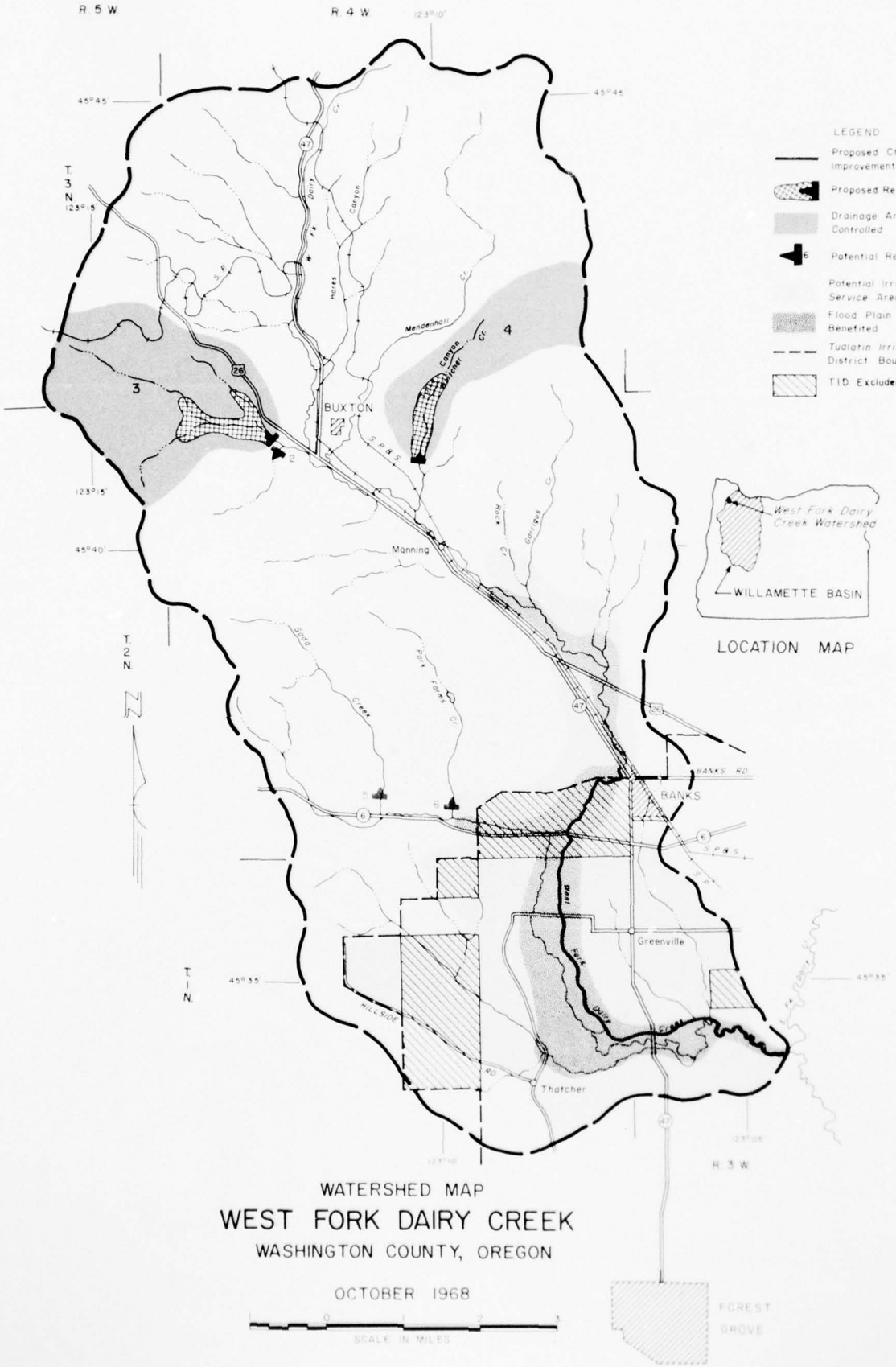
The West Fork Dairy Creek project is one of two in Tualatin Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, would be located in the Washington County SWCD. Approximately 67 percent of the 50,190-acre area is in forest and woodland. In total, 250 farms are involved. There are 1,200 acres in irrigated cropland, 12,300 acres of nonirrigated cropland, and 1,500 acres of pasture.

a. Proposed Structural Measures. - The project would consist of two reservoirs, with a combined capacity of 14,200 acre-feet; channel improvements for flood prevention; an irrigation distribution system; and basic recreation facilities.

(1) One reservoir would be at site No. 449 (SCS 3) in Section 5, Township 2 North, Range 4 West. Tributary drainage area would be about 4.8 square miles with an average annual yield of 12,100 acre-feet. A dam about 130 feet in height would raise the water surface to about 400 feet, m.s.l., and create a reservoir with a capacity of 8,100 acre-feet and a surface area of 170 acres. The reservoir would provide an irrigation water supply for watershed lands and incidental flood control.

(2) A second reservoir would be at site No. 435 (SCS 4) in Section 3, Township 2 North, Range 4 West. Tributary drainage area would be about 3.3 square miles with an average annual yield of 7,000 acre-feet. A dam about 100 feet in height would raise the water surface to about elevation 360 feet, m.s.l., and create a reservoir with a capacity of 6,100 acre-feet and a surface area of 120 acres. This reservoir would also provide storage for irrigation water supply and include basic recreation facilities to serve the estimated initial annual use.



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(3) Channel improvements totaling about 6.0 miles in length would be made on West Dairy Creek from the mouth upstream. Capacities would be provided for 3-year flood protection in agricultural areas and 50-year protection in existing or projected urban and built-up areas.

(4) Irrigation facilities would consist of a distribution system using existing channels, new canals, or pipelines.

b. Project Effects. - The proposed project would reduce the average annual flood plain from 2,130 acres to 420 acres and reduce flood damages by 80 percent. Recreation facilities at site No. 435 would serve an initial use estimated at 40,000 visitor-days annually, including a reservoir fishery. A full irrigation supply would be provided for 3,000 acres.

c. Project Costs. - The total project would cost in the order of $3.7 million, of which about $3.2 million would be for structural measures. Of the total cost, approximately $1.9 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $138 thousand and $129 thousand, respectively, for a B:C ratio of 1.1 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be approximately 0.8 to 1.

e. Current Status. - An application for assistance was submitted in 1958. Sponsors currently include Washington County SWCD, Buxton Community Club, Sunset Chamber of Commerce, Dairy Creek Farm Bureau, Manning Social Club, and Oregon Association of SWCD's.

Fairview Creek Watershed Project

The Fairview Creek Project is one of two in Columbia Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, would be located in the East Multnomah SWCD. About 10 percent of the 15,600-acre area is in forest and woodland. In total, about 200 farms are involved. There are about 5,000 acres of irrigated cropland, 2,000 acres of non-irrigated cropland and 2,000 acres of pasture.

a. Proposed Structural Measures. - The project would consist of about 2.9 miles of channel improvements for flood prevention. Capacities would be provided for 3-year protection in the agricultural areas and 50-year protection in existing or projected urban and built-up areas.

b. Project Effects. - The proposed project would reduce an average annual flood plain from about 90 acres to 10 acres and reduce flood damages by 95 percent.

c. Project Costs. - The total project would cost in the order of $127 thousand, of which about $70 thousand would be for structural measures. Approximately $85 thousand would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of $6.5 thousand and $4.8 thousand, respectively, for a B:C ratio of 1.3 to 1 at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be about 1.1 to 1.

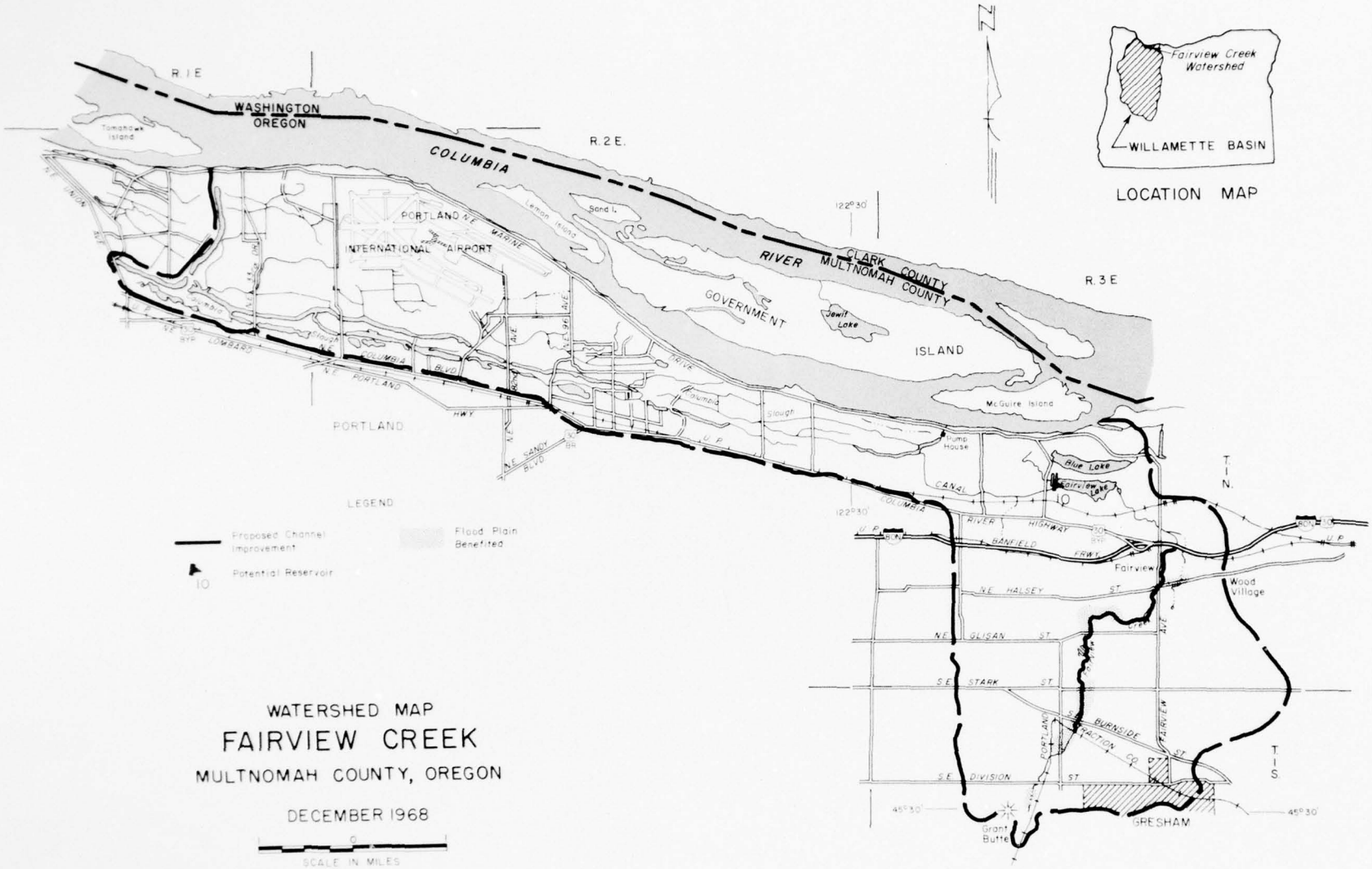
e. Current Status. - An application for assistance was submitted in 1963. Sponsors currently include East Multnomah SWCD, Section Line Drainage District, Multnomah County Drainage District No. 1, City of Gresham, Fairview Creek Planning Commission, and Oregon Association of SWCD's.

Johnson Creek Watershed Project

The Johnson Creek project is one of two in Columbia Subbasin which were selected for early action. The following information is summarized from the SCS Watershed Investigation Report, in which additional details are available.

The project, as shown on the accompanying map, would be located in the East Multnomah Company County and North Clackamas County SWCD's. About 18 percent of the 28,800-acre area is forest and woodland. In total, 350 farms are involved. There are 2,200 acres of irrigated cropland, 4,600 acres of nonirrigated cropland, and 2,800 acres of pasture.

a. Proposed Structural Measures. - The project would consist of three reservoirs, with a combined capacity of 5,350 acre-feet; and basic recreation facilities.



WATERSHED MAP

FAIRVIEW CREEK

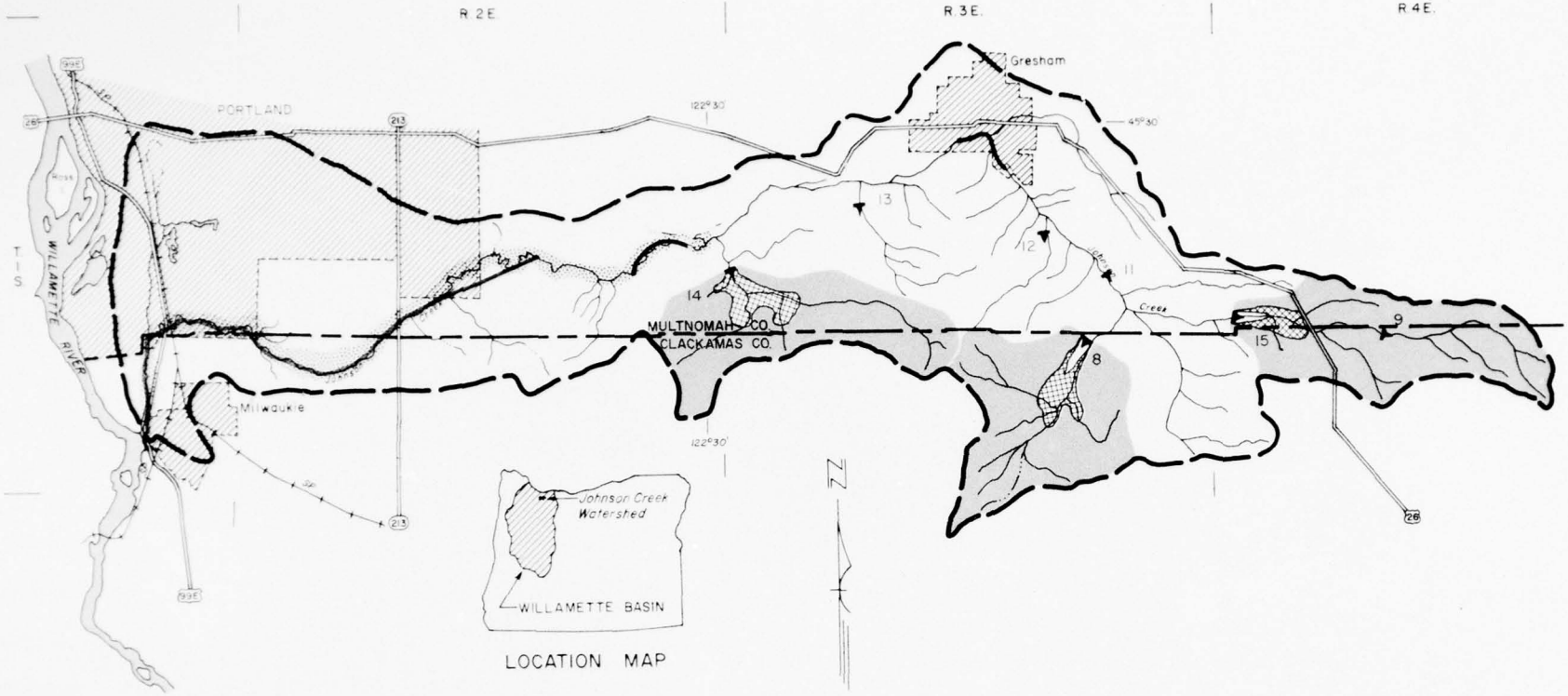
MULTNOMAH COUNTY, OREGON

DECEMBER 1968

SCALE IN MILES

M7-0-21039-L

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE



LEGEND

- Corps of Engineers Channel Authorization
- Proposed Reservoir
- Drainage Area Controlled
- 13 Potential Reservoir
- Flood Plain Benefited

WATERSHED MAP

JOHNSON CREEK

MULTNOMAH & CLACKAMAS COUNTIES

DECEMBER 1968

1 0 1 2

SCALE IN MILES

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE

M7-0-20870-L

(1) One reservoir would be at site No. 515 (SCS 8), in Section 26, Township 1 South, Range 3 East. Tributary drainage area would be about 3.8 square miles with an average annual yield of about 6,500 acre-feet. A dam about 60 feet in height would raise the water surface to about elevation 470 feet, m.s.l., and create a reservoir with a capacity of 3,260 acre-feet and a surface area of 180 acres. The reservoir would provide storage for flood control and include basic recreation facilities to serve the estimated initial annual use.

(2) A second reservoir would be at site No. 591 (SCS 14) in Section 19, Township 1 South, Range 3 East. Tributary drainage area would be about 4.1 square miles with an average annual yield of about 5,000 acre-feet. A dam about 70 feet in height would raise the water surface to 350 feet, m.s.l., and create a reservoir with a capacity of 1,080 acre-feet and a surface area of 100 acres. The reservoir would provide storage for flood control.

(3) A third reservoir would be at site No. 592 (SCS 15) in Section 19, Township 1 South, Range 4 East. Tributary drainage area would be about 3.8 square miles with an average annual yield of about 10,100 acre-feet. A dam about 50 feet in height would raise the water surface to about elevation 500 feet, m.s.l., and create a reservoir with a capacity of 1,010 acre-feet and a surface area of 80 acres. This reservoir also would provide storage for flood control.

b. Project Effects. - Flood storage in the three reservoir sites would reduce peak flows of Johnson Creek at the Sycamore Gage by approximately 35 percent. Flood storage, in combination with the authorized channel improvements of the U. S. Army Corps of Engineers downstream from the Sycamore Gage, will virtually eliminate flood damages on Johnson Creek now estimated to be approximately $110,000 annually. Recreation facilities would serve an initial use estimated at 60,000 visitor-days annually, including a reservoir fishery.

c. Project Costs. - The total project (excluding Corps of Engineers channel improvements) would cost in the order of $2.2 million, of which about $2.1 million would be for structural measures. Of the total cost, approximately $1.4 million would be borne by PL 566 funds.

d. Economic Analysis. - The Watershed Investigation Report shows annual benefits and costs of about $109 thousand and $76 thousand,

respectively, for a B:C ratio of 1.4 to 1, at 3-1/4 percent. With annual costs based on 4-5/8 percent, and no change in benefits, the ratio would be about 1.1 to 1.

e. Current Status. - Local governments are actively considering sponsorship of a project that involves both the upstream storage and the authorized Corps of Engineers downstream channel improvement. Sponsors currently include the East Multnomah and North Clackamas SWCD's; Multnomah and Clackamas Counties; Cities of Portland, Gresham, and Milwaukie; Columbia Region Association of Governments; and the Oregon Association of SWCD's.

Potential Private-Sector Projects

Private-sector projects which appear most likely to be developed during or shortly after the early-action period include nuclear-fueled thermal electric generating installations and recreational facilities.

Basin Nuclear-Fueled Thermal Electric Generation

Several potential plant locations for 1,000-megawatt plants are under study. Some are in the basin; some are on the Oregon coast. So far as is known, no site selection has been made. Most, if not all, of the in-basin sites would involve use of a cooling pond. None would be developed on the basis of using natural flows for once-through cooling; such action could not be taken under State standards for water quality (temperature). Use of cooling ponds would limit water requirements to something in the order of 35 cubic feet per second. That requirement, however, would be principally consumptive, to offset evaporation and other at-plant losses.

One site under study could be used, by provision of additional storage capacity, as an element of the upstream storage alternative discussed in connection with Fern Ridge Reservoir.

The probable cost of a 1,000-megawatt power-generating installation, without facilities related to Fern Ridge Reservoir, would be in the order of $200 million. Annual operation and maintenance cost probably would average about $25 million.

Studies for a project of similar magnitude in Santiam Subbasin also are underway. Cooling probably would be provided by development of a

cooling pond. Makeup water, in the order of 35 cubic feet per second, would be required to offset evaporation and losses. The needed supply could be obtained in part from natural flows and in part from storage, either existing or new, depending on the site finally selected. Costs would be similar to those noted above.

Because of the current nature of those two study activities, this discussion has been presented in connection with the early-action elements of the plan. However, in view of uncertainties of timing, for planning purposes the potential developments and their accomplishments have been considered long-range features.

Other Projects

No other specific identification of private-sector power projects within the basin study area has been made. Some of the 47,000 acres of private irrigation development projected to occur within the early-action period might be categorized as projects. An important adjacent development, along Columbia River immediately downstream from the study area boundary, is the nuclear-fueled 1,000-megawatt generating installation being planned for construction by Portland General Electric Company. That plant will assist in meeting basin power demands and might provide a potential energy source for a possible long-range pumped-storage installation either in or adjacent to the basin.

In addition to the power-generating development, there is a considerable potential for private-sector or joint public-private recreation development and for private irrigation development. A potential Fanno Creek recreation project, under study by the Tualatin Park and Recreation District, is probably the most advanced of any private-sector recreation proposals. At a cost in the order of $20 million, that project would include a 300-acre lake on 800 acres of land, with camping and picknicking facilities, a stadium, and related developments. The proposed agency-public coordinating committee discussed in connection with early-action recreation programs would be expected to assist in planning for other such development. Also, as discussed in connection with fish and wildlife programs, there will be opportunities for private participation in provision of both fishing and hunting opportunities. Private irrigation development would take place both on an individual basis and under already discussed programs.

EARLY-ACTION EFFECTS AND IMPACTS

Effects of the overall plan, in terms of total service rendered, are illustrated by Table V-15. The estimated effects of early-action plan elements, in the same functional fields, are summarized in Table V-17.

The relatively high degrees of accomplishment shown in Table V-17 would be accompanied by some unavoidable adverse impacts in some functional areas. The following paragraphs discuss, by functions, the effects and impacts of early-action elements of the plan.

Fish and Wildlife

Plan implementation would increase fish production and fisherman access; at the same time, it would reduce the extent of freeflowing streams and increase the area for reservoir fishing. It would increase big game production per unit of habitat area, and improve hunter access, but reduce the extent of habitat. Thus, for both fish and wildlife, it would have beneficial and adverse aspects. Those aspects, as related to early-action elements of the plan, are discussed as follows:

Anadromous Fish

Plan effects on the anadromous fish runs of basin streams would be dramatic. The plan provides the following significant potentials for major benefit:

1. Increased low-water flows of good quality, together with programs for at-source treatment or elimination of wastes and completion of Willamette Falls fish ladder, and improvement of conditions for downstream migrants at the Falls to permit anadromous fish to migrate upstream and downstream in Willamette River at all appropriate times. This would include the effects of making fish life enhancement a recognized primary purpose of storage projects and of operating, under that recognition, to provide desirable flows particularly in late summer and fall. Such late-season flows have been provided only to a limited degree, only in recent years, and then only as an interim emergency measure beyond the provisions of existing project authorizations. Flows released from storage as a part of the fishery enhancement function would be used, to the extent necessary to supplement natural flows, to provide total Willamette Falls Fish Ladder flows in the order of those shown in Addendum A to Appendix D, Fish and Wildlife.

AD-A036 765 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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6 OF 7
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Table V-17

Accomplishments of early-action plan elements, versus early-action and long-range residual needs projections

Functions to be Served	Units	Percent of Satisfaction 1/ Early-Action 2/	Long-Range 3/
Fish and Wildlife:			
Fish:			
Spring chinook salmon	Number of fish	49	14
Fall chinook salmon	" " "	36	15
Coho	" " "	20	5
Summer steelhead	" " "	3	1
Winter steelhead	" " "	55	11
Trout	" " "	461	115
All warm water	" " "	0	0
Wildlife:			
Big game	Hunter-days	28	14
Upland game	" "	60	36
Waterfowl	" "	69	33
Flood Control:			
Annual damages prevented	Aver. ann. dollars	41	27
Effective 4/ storage	Acre-feet	16	16
Irrigation:			
Water supply	Acre-feet	100	97
Area irrigated	Acres	100	61
Land Measures & Watershed Protection:			
Private land treatment	Acres	40	40
	Dollars	40	40
Watershed land treatment	Acres	51	51
	Dollars	36	36
Municipal & Industrial Water Supply	Acre-feet	100	16
Navigation:			
Wood chips	Available tonnage	34	34
L.P. gas	" "	100	100
Greases	" "	100	100
Asphalt	" "	100	100
Agricultural chemicals	" "	100	100
Electric Power:			
Firm energy	Million kilowatt-hours	100	9
Peak load	Kilowatts	100	9
Water-Related Recreation:			
Resource capacity	Recreation-days	5/	265
Facilities	" "	111	22
Water Pollution Control	Flow, cfs 6/	232	77

1/ To the degree identified; see Tables V-6 through -14 and accompanying text.
2/ Based on needs projected to 1980 and assumed availability of early-action services at that time.
3/ Based on needs projected to 2020 and continuation of services at the early-action level.
4/ Effective downstream from mouth of Clackamas River; includes consideration of need for 305,000 acre-feet on that stream.
5/ 1980 needs are satisfied by assured accomplishment.
6/ For Willamette River in the Portland harbor area in August.

2. Project facilities and/or operating techniques to permit rearing of anadromous juveniles in reservoir pools. The necessary techniques are now being developed and tested at the existing Fall Creek, Green Peter, and Cottage Grove Reservoirs. Results to date at Fall Creek indicate the potential for a very major increase in production in return for a small increment of cost. In order to fully evaluate this aspect of the plan, and make best use of the potential involved, additional studies should be made immediately. With the findings of such studies embodied in project facilities and project operating plans, needed fishery program funding could result in a manyfold increase in anadromous fish production.

Overall, the effect of the basin comprehensive plan on anadromous fish resources could be to offset and mitigate all losses and contribute significantly to the magnitude of the resource. The fishery agencies are optimistic that, with proper detailed planning and implementation, the plan could result in ability to: (1) meet local sport and commercial fishery needs, and (2) contribute a larger increment of supply to national and international markets.

If considerations and provisions as discussed above and in Appendix D were not implemented, the impact of the plan could be detrimental. Lack of needed flows of good quality water would negate gains represented by the new fish-passage facilities being constructed at Willamette Falls. Also, that lack probably would destroy new runs of fall chinook and coho now being established upstream from the falls. Failure to operate appropriate storage projects in a manner consistent with rearing of anadromous juveniles could eliminate much, if not all, of the major benefits which now appear probable. Failure to provide essential mitigation features, coupled with the effect of low flows of poor quality and failure to make use of reservoir potentials, could result in decimation--or even destruction--of the existing resource.

In summary, the impact on anadromous fish would be dramatic--the potential and probability are for major benefit, but the possibility of severe damages remains if implementation falls short of that outlined.

Resident Game Fish

Plan effects on resident game fish would be less significant than those on anadromous fish.

Project construction would reduce stream spawning, rearing, and fishing potentials for trout. Reservoirs would provide an extensive still-water fishing potential as a substitute for stream areas lost. If an adequate stocking program were implemented, the result could be an increase in number of fishermen accommodated, and possibly an increased level of success, as compared to the present stream fishery. However, the substitution of a reservoir fishery for the stream fishery would represent a loss in the view of many fishermen. Proposed new fishing channels, if properly developed and managed to maintain appropriate environment, could offset that loss. The provision of improved access to streams and stream reaches now little used could add to resource utilization and, with adequate stocking, help to maintain present success levels in the future.

Warm-water fish, which generally are in adequate supply, would not be appreciably affected by the plan. Improved access facilities would aid in resource utilization, and perhaps help to hold the demand for trout fishing to a lower level.

Wildlife

Water development portions of the plan would be detrimental to wildlife without full compliance by the construction agencies with recommendations in the Fish and Wildlife Appendix. Wildlife habitat, except habitat for waterfowl, would be lost in each of the proposed reservoirs. Drainage would destroy waterfowl and upland game habitat. Channel improvement would cause considerable loss of habitat for all species, but such loss could be reduced by proper planning in construction.

A comprehensive plan for Willamette Basin has been developed under provisions of Senate Document 97, the Fish and Wildlife Coordination Act, and other Federal laws. An overall loss to wildlife from project construction is therefore not anticipated because compensation for such losses would be provided at project cost.

Measures to compensate for anticipated losses would be developed by the construction agency involved, in cooperation with Oregon State Game Commission and the Bureau of Sport Fisheries and Wildlife. It may be necessary in some cases to combine mitigation responsibilities of several projects into joint compensatory developments if full mitigation is to be achieved at least cost to the projects.

Incidental benefits to waterfowl would accrue from water level management in Fern Ridge Reservoir, and waterfowl as well as other birds would benefit from provision of an assured water supply for refuges and management areas. Program and management elements of the plan would result in increases in usable wildlife habitat, improved or increased access to wildlife populations, and improved distribution of use commensurate with resource availability.

Flood Control

Proposed structural and nonstructural flood control measures, acting together, would reduce present and future levels of flood damages. The structural measures would prevent or reduce damages to lands, and to such developments as would be made in flood plain lands in the absence of structural and nonstructural flood control measures. In addition, increased use could be made of flood plain lands, and damages to the additional development involved would be prevented or reduced.

Structural measures alone, however, would encourage the development of a false sense of security, and accompanying unwarranted encroachment on the remaining flood plain. Thus, appropriate nonstructural measures--local regulation of flood plain use--must be put into effect if the plan ultimately is to accomplish significantly more than a relatively minor enlargement of areas now flood-free.

The flood control plan consists of: (1) existing, authorized, assured, and early-action projects and programs which contribute to control and confinement of flood flows, and (2) a proposed flexible local program of flood plain use regulation. Those elements, acting together, would reduce future damages to lands and improvements now in the flood plain. Further, increased use of flood plain lands, consistent with the degree of remaining flood hazard, would be made possible.

The overall effects, as of 1980, except for flood plain use regulation, would be to achieve about 90 percent of the benefits theoretically obtainable at that time by complete elimination of flooding. Corresponding average annual monetary benefits, including increased land use, would total about $44.2 million as of 1980, or an increase in the order of $4.8 million attributable to early-action projects and programs. Flood plain regulation, as proposed, would reduce the potential for increases in damage potential.

Adverse effects, or impacts, of the flood control portion of the plan include:

a. Loss of productive forest and agricultural lands in reservoir areas. Those losses are reflected in estimated costs of land acquisition.

b. Environmental losses, discussed separately in subsequent text. Those losses would be minimized by project measures to reduce detrimental impact.

c. Some loss of freeflowing streams for fish spawning and rearing and fisherman use.

d. Loss of wildlife habitat in the reservoir and project service areas.

e. Some possible loss of natural fish production, if channel improvement elements cannot be planned to avoid adverse affects on fish habitat.

Adverse effects, on flood control, of other plan elements would be minor. The principal factor, so far as storage projects including flood control are concerned, is the need for annual filling and the consequent seasonal reduction in flood control capability. Because of the annual climatic sequence, however, the basic operating schedule has been proven to be able to provide flood control capability closely consistent with the potential for damaging floods. Further study will be required to determine whether any improvement in filling capability can be made without reducing flood control capability and overall benefits.

Another factor with some adverse effect on future flood control was the setting aside of certain project sites in favor of environmental management. Because no flood control projects in the early-action category were set aside, no immediate adverse effect will be noted. There will be ample opportunity for initiation of appropriate flood plain use regulations, and for any needed further evaluation of the management program, before any project now set aside would be critically needed for flood control.

Irrigation

The early-action elements of the plan include private, Federal and Federally-assisted developments to meet irrigation needs.

Private developments include those by individuals and small groups utilizing natural flows, farm ponds, ground water, and storage. The private segment of the early-action plan would result in a net increase of about 47,000 irrigated acres.

Federally-assisted actions embodied in PL 83-566 small watershed proposals would place an additional 59,000 acres under irrigation during the early-action period. About nine percent of that acreage could be irrigated by use of storage in existing and authorized Federal reservoirs, as a single-purpose alternative to construction of storage within the watershed. Local decisions will determine action on those alternatives.

Federal project-type irrigation development in the early-action plan would place an additional 262,000 acres under irrigation. One of the reservoirs included in that development also could be constructed under either the PL 83-566 or the PL 84-984 program. Local decisions will determine actions on those alternatives.

In total, the early-action irrigation plan elements provide for irrigation of 368,000 acres of land. Adding this early-action increment to existing (244,000 acres), authorized, and assured (23,000 acres) development results in a total irrigation development of 635,000 acres. That total is about 63.5 percent of the irrigation development considered necessary to meet the basin's proportionate share of national needs for food and fiber by 2020.

A portion of the water reserved for irrigation in existing and authorized Federal reservoirs would be utilized during the early-action

period. A net increase of about 72,000 acres is expected to be irrigated from that source, bringing the total to about 75,000 acres. A considerable amount of additional storage in those reservoirs would be available for irrigation under existing authorizations and a large portion is expected to be used for that purpose in the long-range period. However, consideration should be given to the possible reassignment of that storage to other functions, depending on relative needs, benefits, and availability of alternative sources of supply. Further studies will be needed to identify amounts and locations.

New storage elements in the early-action plan would provide additional water for irrigation use. However, with only minor exceptions, new storage is proposed to irrigate only those lands which cannot be economically supplied from existing and authorized reservoirs.

The irrigation elements of the early-action plan would have a profound effect on the basin's economy. Irrigation provides the opportunity to grow a wider range of crops and the means for intensifying production on the individual farm. With irrigation there is the assurance that predictable yields of specified quality can be obtained. The early-action irrigation elements would support a growing agricultural economy. Additional job opportunities would be created in processing and marketing and increased amounts of supplies, equipment, and services required by the farmer would create a larger volume of business for service industries. Nearly all sectors of the basin's economy would be stimulated.

Irrigation developments can and should make maximum contribution to the environment. The esthetic impact, in season, of lush green irrigated fields and mature crops is sure to enhance the environmental aspects of the basin. Irrigation structures would be made to appear esthetically pleasing and in harmony with the landscape. Further enhancement can be obtained through contributions to other water resource functions. Wildlife refuges can be incorporated into irrigation and drainage developments and their usefulness magnified by properly controlled water supplies. Water quality and fishery habitat can be improved where natural stream channels are used to deliver irrigation water. Irrigation developments can contribute substantially to recreation pursuits where proper facilities are provided. An example might

be recreation trails along irrigation canals together with proper safety measures to minimize hazards.

Adverse effects, or impacts, of the early-action irrigation plan would be minor. Reservoir effects would be as discussed for flood control. Irrigation development would be to the detriment of some forms of wildlife, but for others it would provide a source of additional food supplies. Irrigation canals could cause loss of migrating game animals, but practical means of passing migrants have been developed in other areas and would be used as necessary. Return flows from irrigation could be detrimental to water quality, but proper management would prevent wasteful overland return flows. Also, further research on agricultural chemicals would reduce the possibility of toxic effects of return flows.

Land Measures and Watershed Protection

The various early-action programs for land measures and watershed protection, as outlined herein and detailed in Appendix G, have as basic goals (1) the protection of permanent soil values and (2) the restoration and preservation of hydrologic normality on the watersheds. Achievement of those goals would keep basin lands in a state of readiness to meet demands imposed by changing land use. It would help to insure that the quality of water emanating from basin lands is acceptable for all uses. Other effects would include the improvement of fish and game habitat, and development, by research, of new knowledge as to improved soil and water management.

Overall, the proposed programs, ongoing, accelerated, and new would meet a reasonable percentage of the needs associated with those goals if carried out at the scale proposed. There would be no known adverse impact; rather, the cost of program measures would be more than offset by prevention of soil loss, reduced productivity, deterioration of water quality, and loss of fish and game habitat.

Municipal and Industrial Water Supply

The early-action elements of the plan include about 50 new multiple-purpose reservoirs, large and small, distributed among nine of the 11 subbasins. A majority of those reservoirs, which would provide a total of about 1.6 million acre-feet of storage space, would be located in

the area west of Willamette River. The stored water which would be available in that area of summer water shortage could provide a substantial degree of service to municipal and industrial needs.

The two subbasins, 9 - Clackamas and 11 - Sandy, in which no early-action storage is proposed are adjacent to the Portland metropolitan area. That area is served by the Bull Run system of the City of Portland, in Subbasin 11. Appendix H shows that the City has plans for provision of an additional 11,000 acre-feet of storage in that system by about 1985. With that storage, and considering the physical availability of water, of admittedly lower quality, in Willamette and Columbia Rivers, no possibility of an actual shortage of water is foreseen.

Thus, the overall effects and impacts of early-action plan elements apparently would be to provide a means of satisfaction for substantially all projected M&I needs which could not be met by use of natural flows and ground water. However, some communities and areas would have to use sources of lower quality than presently used. The total impact of such use would be offset to a considerable degree by water pollution control, flow augmentation, and land and watershed measures for improvement of water quality. Nonetheless, public education as to the availability and effects of available water treatment techniques probably would be necessary to obtain public acceptance of some available sources.

Navigation

The effect of navigation proposals in the early-action portion of the plan cannot be fully evaluated until more detailed studies permit a decision as to both the depth and upstream terminus of a modified project.

Possible adverse impacts of any finally-selected plan would be principally on fish life, and possibly wildlife and natural environment. Fish life impacts would be the adverse effects of channel dredging on spawning and rearing areas and, to a very limited degree, on turbidity levels during dredging. Wildlife and environmental impacts would be those relating to location and extent of areas for disposal of material dredged from the channel. Inadequate planning would permit spoil disposal to be detrimental to recreation under the Willamette Greenway, or Park System, program. Plans for extent and timing of dredging would have to be

developed in cooperation with fishery and recreation agencies. Such cooperative planning should include consideration of the flow augmentation capabilities of reservoirs in the plan, and the potential for multiple benefits from such use of stored water, so as to minimize need for dredging.

Power

The study revealed only a modest potential for additional development at conventional hydropower-generating installations. Some of that potential was excluded from the plan under the environmental management program; the balance was not economically feasible or deferred for long-range development.

Non-Federal development, during the early-action period, of thermal generating plants could be of considerable significance. However, there are no specific proposals for such development at this time.

Thermal generating plants, whether fossil-fueled or nuclear-fueled, have the potential for adverse effects on air or water quality, or both. Also, public acceptance of siting and/or safety of nuclear-fueled plants may pose problems. The power industry is working toward optimum preservation of environment along with satisfaction of power demands. Also, research now underway under the sponsorship of Oregon State University may lead to developing methods for beneficial use of warmed cooling water from thermal plants. Thus, in the long-range period, such development can be anticipated.

Recreation

The overall plan, as described herein, generally would enhance the outdoor recreation aspects of life in the basin. Proposed facilities and continuation of ongoing programs would go far toward meeting present and future needs. Overall, because of the location of population centers with respect to proposed projects and resources, there will be some lack of balanced distribution of recreation opportunities. Proposed agency-public coordination in recreation program planning and implementation, however, can work to improve that situation. This would be particularly true for areas west of Willamette River where present lack of facilities creates a need for private, as well as public, development.

Recreation facilities developed after the base year (1963) at existing, authorized, assured, and early-action storage projects would provide for roughly 6.3 million recreation-days of annual use by the end of the early-action period. Even though projects would not necessarily be in the best location to satisfy recreation needs, surplus water-surface capacity would be available to satisfy increasing demand after the early-action period. Programs would satisfy additional early-action-period facility needs.

Development of facilities provided for by the plan would tend to minimize overuse of fragile, undeveloped areas which might be subjected to increased pressure because of inundation of some areas. At the same time, planned development of access to additional natural areas would permit distribution of recreation-user pressures over larger areas and reduce damage attributable to excessive use. Further, the proposed program of management for environmental preservation, discussed separately, will help to retain essential natural and scenic areas.

The impact, on recreation, of proposed projects and programs varies from beneficial to possibly highly detrimental. Most of the impact would be in the esthetic aspects of recreational enjoyment; overall, those aspects of individual projects depend principally on the resource existing prior to construction and on the manner in which subsequent planning and construction are accomplished.

Proper planning, construction, and operation and maintenance, with recreational use and enjoyment as an objective, will be essential for all projects. If such concepts are utilized in full, with mitigation of damages and emphasis on enhancement, the overall effects on recreation would be beneficial. Project descriptions and discussions herein embody statements of appropriate concepts and objectives. Accomplishment of those objectives, by agency and public cooperation and coordination, will provide final proof of the recreational impacts of the plan.

Ongoing and proposed new programs, particularly those for land treatment, watershed protection, and environmental management, generally would enhance outdoor recreation. Program measures for fish passage, if elimination of scenic waterfalls and rapids were involved, would be detrimental to the quality of recreation experience. Irrigation would enhance the appearance of agricultural areas. Some parts of irrigation

conveyance and distribution facilities offer the possibility of scenic trails, particularly needed in heavily populated areas. To the extent that flows adequate or beneficial for fish life are provided, the opportunity for and value of streamside recreational programs would be enhanced. This would be particularly true on Tualatin River and other west side streams which now suffer severe water shortages during the principal recreation season. However, enhancement attributable to increased flows could be more than offset by the detrimental effects of channel work and bank stabilization, if planning and construction are not done with proper consideration to esthetics. To the extent permitted by implementation, program measures for cooperative planning for recreation and maintenance of environmental values will be beneficial.

Water Pollution Control

The basic and essential action for control of water pollution is at-source treatment of wastes or other action to prevent pollution. Sedimentation is undoubtedly the oldest polluter of streams. Plan recommendations involving land treatment, watershed protection, and channel stabilization measures will lessen the detrimental effects that sediment has on water quality. However, some of the polluting effects of a growing population and all its activities are not readily subject to control and/or treatment. Further, practical and economical means of waste treatment, to remove all deleterious elements from all types of discharged wastes, have yet to be developed. The State's pollution control program is operating under standards approved by the Secretary of the Interior. It is aimed at, and can be expected to achieve, 85-percent BOD removal for wastes from all of the basin area, and 90- to 95-percent removal in some areas, prior to 1975. By about 2020, BOD removal would be up to 90 percent for all areas, with some areas up to the 95-percent level. Also, by 2020, a considerable amount of sediment reduction will be effected by watershed management, land treatment, and channel stabilization.

Nonetheless, there would be a need for increased flows to dilute the remaining pollution load. The existing, authorized, and early-action storage could provide most of the flow augmentation needed,

during and for a time after the early-action period, for Willamette River in the critical Portland Harbor reach, as well as in identified reaches of tributary streams. One of the effects of such improvement is reflected in estimates of substantially increased anadromous fish runs based on experience in the last few years. Another mirror of anticipated effects is the planning underway for recreational development on streams such as Willamette and Tualatin Rivers. If the planned water quality control accomplishment is not realized, the principal value of those planned developments would be negated.

Environment

Both programs and projects in the plan would have an impact on overall basin environment. The following discussion summarizes environmental effects and impacts.

Programs

Willamette Basin lands are about two-thirds forested. Half of the forested lands are in public ownership, administered principally by the U. S. Forest Service and the Bureau of Land Management. Thus, the land treatment and watershed protection programs of those agencies would affect about one-third of the total basin area. For that reason, the environmental effects and impacts of those programs would be among the most significant of all those for the total plan. The programs are aimed at restoring desirable conditions and keeping basin lands in a state of readiness to meet growing and changing needs, and at improving water quality at the source. They include fish and wildlife, recreation, and environmental aspects, as well as timber production and harvest, and other multiple-use functions. For those reasons, implementation of the plan would go far toward improving overall environmental quality and maintaining those aspects which now are desirable. Similarly, most of the land treatment measures and programs for agricultural areas would tend to improve overall environment.

The proposed environmental management program would provide for protection of flows and natural streamside environment. It covers all but excepted portions of 29 specifically named streams, plus all streams in five wildernesses and three designated forest recreation areas. On those named streams it covers more than 1,250 miles of natural channel,

and the immediately adjoining lands. Implementation would protect natural conditions against immediate change, preserve freedom of choice, and provide a basis for reasoned choice in the future. However, the program as proposed represents less than the accomplishment recommended by the Recreation Committee. Table V-16 accompanying text on the programs, shows the exceptions which were made in favor of potential new development. It should be noted that some of the projects for which exceptions were made would have partially offsetting beneficial effects on streamflows and water quality, and all would be planned to minimize adverse effects. Thus, while the exceptions represent a loss of free-flowing stream values in the reaches involved, there would not be the loss of all desirable environmental qualities. Also, downstream reaches often would benefit by increased summer flows of good quality water.

Fish and wildlife programs would provide for either or both maintenance and improvement of environmental quality, and for increased use and enjoyment of the resources.

The environmental effects and impacts of other early-action programs, as distinguished from projects or structural measures for the same functions, would depend more on the manner of implementation than on the purpose. For example, programs of assistance in land drainage or irrigation could either emphasize or ignore environmental and fish and wildlife considerations. Each of the agencies with responsibilities for those programs is aware of the growing importance of environmental considerations. For example, many U. S. Department of Agriculture publications and directives emphasize the need for preservation, renewal, and improvement of environment for human, plant, and animal life. The deciding factor, however, will be the views, desires, and capabilities of the public. To the extent that the people concerned are interested, and willing to become involved and bear the costs, environmental quality can be maintained and improved. Similarly, power transmission systems could be planned to be unobtrusive and perhaps compatible with the landscape, or located without regard to effect on scenery. There is, however, a growing recognition of environmental needs in that field, too, which should result in improved conditions.

Projects

Project effects generally would be to cause a change in natural environment at the project site or in the project area. To the degree that beauty is in the eyes of the beholder, all projects will be objectionable to a few, many will have no widespread impact, and a few will be approved by a majority. Structural elements listed for early-action are described as incorporating provisions for minimizing adverse impact, and provisions for fish and wildlife and recreational functions. To the extent that such provisions are satisfactorily implemented, the adverse effects of change in overall natural environment will be at least partially mitigated. Construction agencies, and the private sector, in planning, constructing, and operating projects--particularly extensive channel improvements and potential pumped-storage projects--must recognize the potential for devastation of environment, and take steps to avoid it. On the other hand, the overall effects of reduced flood damage, increased streamflows, and improved water quality would be beneficial to the total basin environment. Provision of mass recreation facilities at reservoirs would tend to reduce pressure on, and delay over-use and damage to, more fragile, natural environment.

Summary

The plan includes both desirable and potentially detrimental aspects, so far as preservation of natural environment is concerned. It includes provisions for future choice in many cases. If properly implemented, in the light of full public knowledge of its potential effects and impacts, it probably would improve the overall basin environment so far as preservation of natural environment is concerned.

UNMET NEEDS

The programs and projects of the comprehensive basin plan would satisfy a high percentage of the projected needs of the basin, as of 1980, 2000, and 2020. Tables V-15 and V-17, respectively, show the accomplishments of the total comprehensive plan and of the early-action elements. The extent of remaining or unmet needs, by functions, as of about 1980 and 2020 would be as shown on Table V-18.

Table V-18

Unmet needs, with the comprehensive basin plan

Functions to be Served	Units	Unmet Needs 1/ Amounts: Early-action 2/	Long-Range 3/
Fish and Wildlife:			
Fish:			
Spring chinook salmon	Number of fish	49,400	290,200
Fall chinook salmon	" " "	118,900	234,700
Coho	" " "	85,300	370,600
Summer steelhead	" " "	115,500	238,000
Winter steelhead	" " "	900	8,300
Trout	" " "	0	0
All warm water	" " "	360,000	960,000
Wildlife:			
Big game	Hunter-days	472,000	1,101,000
Upland game	" "	223,000	606,000
Waterfowl	" "	56,500	264,500
Flood Control:			
Annual damages	Aver. ann. dollars	4,218,000	14,777,000
Effective 4/ storage	Acre-feet	1,803,000	1,522,000
Irrigation:			
Water supply	Acre-feet	0	0
Area irrigated	Acres	0	0
Land Measures & Watershed Protection:			
Private land treatment	Acres	1,566,000	626,000
	Dollars	114,000,000	46,000,000
Watershed land treatment	Acres	244,000	0
	Dollars	17,500,000	0
Municipal & Industrial Water Supply	Acre-feet	0	0
Navigation:			
Wood chips	Available tonnage	2,374,000	1,773,000
L.P. gas	" "	0	0
Greases	" "	0	0
Asphalt	" "	0	0
Agricultural chemicals	" "	0	0
Electric Power:			
Firm energy	Million kilowatt-hours	0	0
Peak load	Kilowatts	0	0
Water-Related Recreation:			
Resource capacity	Recreation-days	0	0 5/
Facilities	" "	0	0 5/
Water Pollution Control	Flow, cfs 6/	0	659

1/ *Additional details are shown in Tables V-6 through -14.*
2/ *Based on needs projected to 1980 and assumed availability of early-action services at that time.*
3/ *Based on needs projected to 2020 and total identified plan services.*
4/ *Effective downstream from mouth of Clackamas River; includes 305,000 acre-feet for that stream.*
5/ *In total; there would be a shortage in the lower subarea.*
6/ *For Willamette River in the Portland harbor area in August.*

UNUSED POTENTIALS

Completion of all elements of the comprehensive basin plan would leave untouched a considerable water resource development potential, but would reduce the natural environmental resources of the basin. For example, Table V-2 shows that opportunities for additional storage development exist in all but three of the 11 subbasins studied. Even those listed opportunities do not represent the total potential; instead, they represent only that part of the total investigated potential which, on the basis of screening studies, now would be ranked next in priority to projects included as long-range elements of the plan. Map IV-1 shows the location of potential sites which were screened as a basis for selection of storage projects included in plan formulation studies.

Also, there are many additional opportunities for development of small amounts of conventional hydropower generation, and for development of large blocks of pumped-storage peaking power generation. None of the six most-favorable potential conventional power-generating developments listed in Appendix J are included as early-action elements of the plan, and only one is included as a long-range element. None of the nine most-favorable pumped-storage power potentials are listed for early-action, and only six are included as long-range elements.

Conversely, environmental management potentials would be enhanced by the elimination of those potential projects from any further development consideration.

In addition to unused storage and power-generation potentials, there are other identified single- and multiple-purpose potentials which are not included in the plan. On a functional basis, those are summarized as follows.

FISH AND WILDLIFE

Fish

Additional production of anadromous fish probably could be achieved by expansion and/or improvement of programs discussed earlier. Any increment of production apparently would be of full value in the commercial fishery. In terms of angler enjoyment of sport fishing in basin streams, however, there might be some question as to the quality of the resulting sport. This would depend on whether increased production and increased success levels attracted additional usage to an extent

which would result in overcrowding of areas to which access would be available. Also, there might be problems of sufficient access to streams. To some extent, crowding problems may be offset by the fact that anadromous fish would be present throughout the year. At present, angling for anadromous fish occurs mainly from March through June.

Further, there apparently would remain some opportunities, perhaps impracticable to develop under future conditions, for further improvements to overall water quality in Willamette River and some tributaries, and for additional improvement of spawning areas, passage at dams, etc. The proposed fishery research, management, and evaluation programs should provide increased knowledge of those, and possibly other, potentials.

Wildlife

With increasing human population and accompanying encroachment on wildlife habitat, the total potential for additional wildlife populations and hunter success appears to be limited to nonexistent. A principal opportunity would seem to lie in proposed research coupled with public education to develop improved management plans and public support for additional development and/or acquisition of wildlife areas. Overall competition for use of available land areas will intensify and measures to increase production on available areas may have to be developed.

FLOOD CONTROL

In addition to storage potentials, there are possibilities for considerable local flood control works beyond those listed in the plan. These include possible construction of a system of levees, to confine flood flows as regulated by storage and/or on unregulated streams; and the full range of local channel enlargement, realignment, and stabilization. Alternative to use of those structural measures, the proposed flood plain use regulations could be continued and additional and more restrictive regulations could be adopted locally if future needs warranted such action.

IRRIGATION

Appendix F shows that by 2020 the total irrigable area in the basin will have been reduced from about 1.7 to about 1.4 million acres. At the same time, it shows that about 0.4 million irrigable acres will remain available for development as of 2020. Thus, a land base for additional irrigation development will exist beyond the level provided for by the plan. It is doubtful that any natural flow will be available as a source of irrigation supply at that time. The available storage opportunities, however, could provide an adequate supply. Also, there may be additional dependable and economically available ground water sources which could be developed for some limited areas.

An aspect of irrigation which represents an opportunity for the future is irrigation of forest lands. The potential for increased production from such irrigation now is unknown, and the plan includes no provisions for its use. Provision of water supply for forest irrigation would require storage development, using sites as mentioned above.

LAND MEASURES AND WATERSHED PROTECTION

The opportunities for additional multiple-purpose service from these programs and measures is limited only by the physical extent of basin land areas, the overall availability of funding, and the desire of basin residents to participate.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

Because of the overall good water supply of the basin, including apparently large ground water reserves and winter flows surplus to known needs, many opportunities remain for developing municipal and industrial supply. In addition to the storage sites listed as opportunities and shown on Map IV-1, there are many small sites which could be developed to store water for use by individual communities and industries. Also, municipal and industrial use involves relatively small consumption of water and effluents can be treated before return to be acceptable in basin streams. Thus, the basin's total water resource represents an opportunity almost limitless with respect to probable demand, for use and reuse as a source of municipal and industrial supply.

NAVIGATION

Development of other than the shallow-draft channel proposed herein apparently would be impracticable in reaches beyond the pool upstream from Willamette Falls. However, if conditions warranted such action, depths up to those in Columbia River could be provided, at least upstream to the Falls. This probably would lower water-surface elevations in the stream and require modification to existing power-generating installations as well as to other navigation facilities. Also, if additional flow augmentation were to be provided by development of storage opportunities beyond the plan, a usable increment of additional depth might be provided upstream from the Falls.

RECREATION

Additional development of recreation facilities, both land- and water-related, would be possible to an extent far beyond that provided by the plan. The principal opportunities will be for development of facilities for more extensive and intensive use of available land and water areas, plus possible new water surface provided by development of storage opportunities. To the extent that both population and other uses and developments encroach on potential recreation areas, and that more intensive use may reduce the esthetic quality of recreation experience, the relative value of the remaining opportunity may be reduced. It would appear that, with increasing population, the resulting demand for intensive-use recreation facilities on a year-around basis would warrant increased private-sector participation in development.

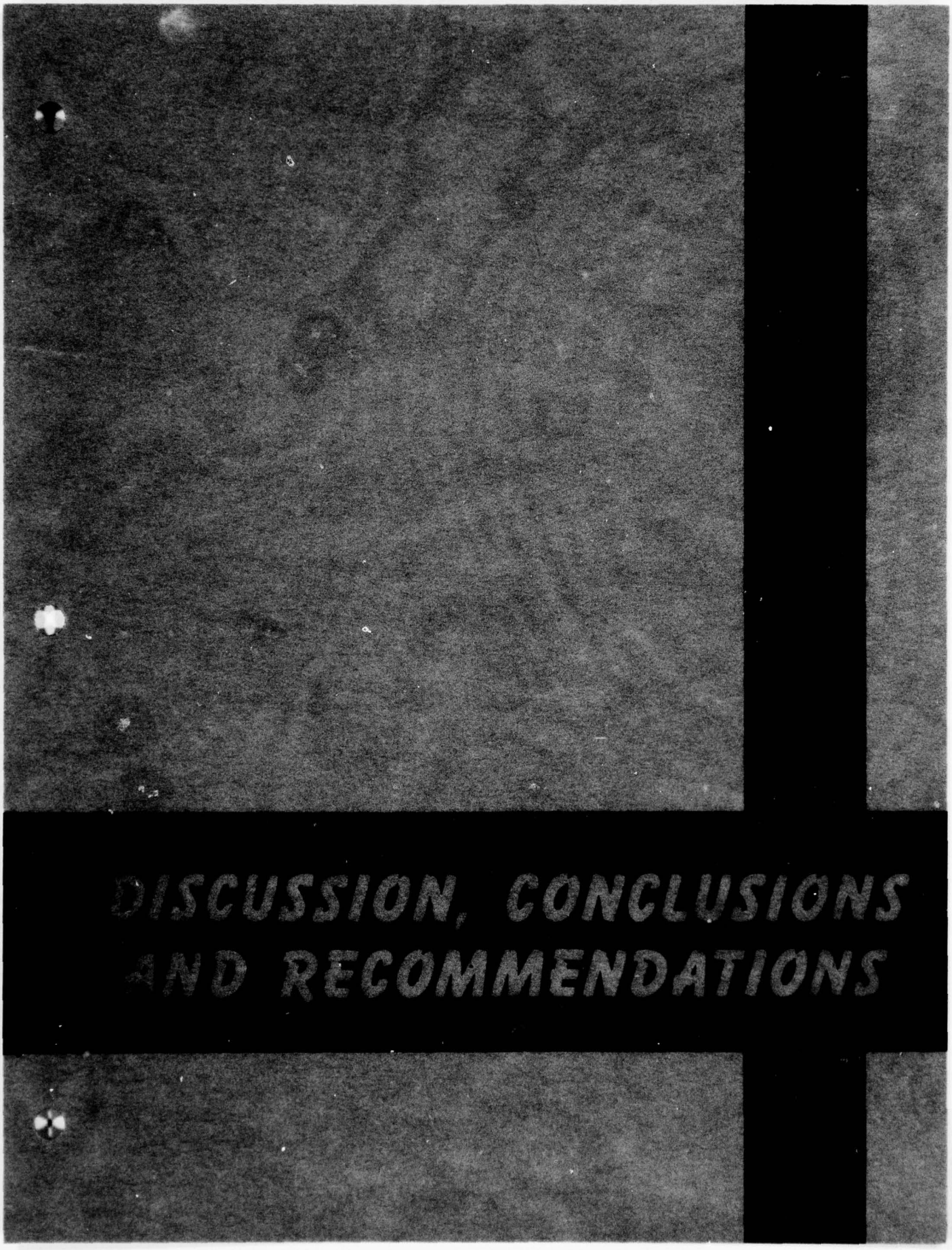
WATER POLLUTION CONTROL

Relatively untouched opportunities include development of facilities for irrigation and industrial use of treated effluents, or even for recycling highly purified effluents for use as a municipal supply. There are opportunities for local action to separate, and possibly improve the quality of, storm drainage waters now collected and carried in combined sewerage systems. Also, the development of storage opportunities could provide a substantial increment in flow augmentation. There is an opportunity and a need for research to develop, and/or control, the use

of agricultural chemicals so as to reduce the adverse effects of residuals and leaching to water bodies. Opportunities also exist for zoning to develop advantageous location of housing and industry and thus facilitate collection and treatment of wastes from an increasing percentage of the total population.

ENVIRONMENT

From the standpoint of preservation of unique and desirable natural areas, environmental opportunities are limited to those which now exist and which will be reduced with time. Overall environment for day-to-day living, however, is synergized from all of the conditions and factors which affect the quality of human life. From that standpoint, there will remain many opportunities and potentials for environmental improvement. Air and water quality, the overall appearance of the basin, floods, free-flowing streams, undeveloped waters, and many other factors will offer opportunities for both preservation and planned additional improvement. Limiting factors will be knowledge of needs and opportunities, which can be obtained by research and studies, and the availability of public support and funds for implementation.


DISCUSSION, CONCLUSIONS
AND RECOMMENDATIONS

G E N E R A L

The Willamette Basin Task Force, a multidepartmental entity chaired by a representative of the State of Oregon, presents this summary discussion and the ensuing conclusions and recommendations as the final product of the basin study, and the consensus of the agencies and interests involved in the study.

The basic concept underlying this multiagency study of water and related land resources is as stated in the Introduction: Willamette Basin now is, and must remain, a generally desirable place for people to live, work, and play.

Under that concept, plan formulation was aimed at meeting present and projected needs and yet maintaining or enhancing those elements which now contribute to the desirable quality of life. Thus, it has resulted in the selection of a plan which is a composite--a mix of existing and new elements, embodying both development and preservation.

That plan provides for service to needs for fish and wildlife, flood damage reduction, irrigation, municipal and industrial water supply, navigation, power generation, recreation, and water pollution control. It includes land measures and watershed protection programs, to preserve basin soils and to restore and maintain hydrologic normality on the watersheds. It includes protection and preservation of desirable natural environment.

The comprehensive basin plan includes ongoing and new programs, and existing, authorized, assured, and new projects. Both the programs and the projects are essential, and complementary, elements of the plan. New project elements of the plan are identified as warranting early or long-range action, depending principally on economic status and magnitude and severity of needs involved. Allowance is made for potential private-sector, as well as agency, development of resources to meet needs. Alternatives embodied in the plan are identified as a basis for reasoned choice, generally at local level. The effects and impacts, on a functional basis, are summarized for the overall plan and presented in more detail for the early-action phase.

The Willamette Basin Task Force believes that the plan will be approved by a majority of those who reside in the basin and are directly concerned; it has sampled their views and opinions through a multitude

of individual and group contacts as discussed under the heading "Public Involvement" in Part III, and at many public meetings, and has provided responsive elements in the plan wherever practical. At the same time, recognizing that no function or need would receive service to the satisfaction of all concerned, the Task Force is aware that there will be some dissatisfaction with the plan. It believes that such conditions are inherent in proper planning for and use of available resources to best meet growing overall needs--that no single interest or need should be favored at the expense of others, so long as the critical needs of health, safety, and sustenance are met.

Overall, the comprehensive plan is well adapted to control, use, and development of water and related land resources to meet present and projected needs. It provides service across the full range of presently recognized functional needs. It is flexible, both as to timing of implementation and because it includes alternatives, or provision for future freedom of choice. It also contains provisions for coordinated private-sector, State, and Federal activities. It provides an areal distribution of new work--programs and projects--responsive to needs under present and foreseeable conditions, over most of the basin area. The exceptions are the three downstream subbasins, where available resources and potentials generally cannot be developed to meet all needs at costs commensurate with benefits. Further, with all plan elements completed and in operation--perhaps about the year 2020--there would remain a substantial backlog of identified opportunities for additional development.

In consideration of all those factors, the Task Force believes that the plan is consistent with the basic study concept. Also, it is responsive, to a balanced degree related to known and projected needs for use of available resources, to the primary National objectives first stated in Senate Document 97: development, preservation of environment, and the well-being of people as an overriding determinant. At the same time, it recognizes the goal of economic efficiency; only those projects for which there is both a pressing need and a prospect of economic justification are proposed for early study and implementation.

However, the plan as developed and presented herein, does not satisfy all of the critieria, and provide all of the information, which

would be necessary to support recommendations for authorization of Federal projects. Thus, additional study, by appropriate agencies and in continued coordination and cooperation, will be a prerequisite to plan implementation. That additional study, in total, will include a continuation and intensification of the public involvement discussed in Part III, to insure responsiveness to all public needs and particularly to environmental needs and desires now more widely held and more clearly stated that at any time during the course of the multiagency study.

ADOPTION OF THE PLAN

The Willamette Basin Task Force concludes that the comprehensive basin plan, described in Part V, should be adopted as a guide to continuing water and related land resource planning. It concludes that approval of the plan, by the Pacific Northwest River Basins Commission, the Water Resources Council and the Departments it represents, and the State of Oregon, would constitute adoption. Such actions would provide support and guidance to all concerned in completing the additional planning which must be done, on all aspects of each potential project, before specific construction recommendations can be made and in scheduling and directing future study of long-range plan elements.

With such support, the Bureau of the Budget and the Congress could be assured that individual agency plans and proposals, in the foreseeable future, would be consistent and compatible. The Task Force recognizes, however, that the plan is neither final, for all time, nor even inflexible within the foreseeable future. It recognizes that change is an inescapable factor in water and land resource planning, and that the plan presented herein will have to be reviewed and updated in the future. Further, it recognizes that unforeseen changes and/or new data to be developed during necessary additional studies may require modifications in timing of development, project scope and functions, or perhaps in project location, even during the early-action period. Accordingly, it concludes that adoption of the plan should provide guidance, but not rigid constraint, on new development proposals such as may result from essential ongoing agency studies. As a specific example, additional detailed study will be required to assess the environmental impact and overall desirability and appropriateness of those early-action projects which would be located on streams which the Recreation Committee has recommended for retention in a free-flowing state. Any significant deviation from the plan, however, should be contingent upon a showing of changed conditions, lack of adverse effect, and overall compatibility with the basic study concept and the remainder of the plan. Further, it concludes that periodic review and updating, perhaps at 10-15 year intervals but to be scheduled as conditions may warrant, will be essential to maintain the value of the plan.

PLAN IMPLEMENTATION

GENERAL

Actions required subsequent to completion of this report include:

1. Plan adoption, as already discussed.

2. Completion of additional agency studies and reports, with recommendations, for potential projects involving Federal responsibility.

3. Authorization of Federal projects and Federal aspects of any projects with joint Federal-private responsibilities.

4. Appropriation of funds for planning and construction of projects, and for prosecution of programs.

5. Continuing coordination and cooperation between and among agencies, the general public, and potential private-sector developers, leading to appropriate agency and private-sector development actions.

Those aspects of plan implementation following plan adoption are discussed and pertinent conclusions are drawn in the following paragraphs.

ASSIGNMENT OF RESPONSIBILITIES

Text in Part V and in the functional appendixes, D through L, identifies agency responsibility for programs. Part V also identifies, for each project in the early-action segment of the plan, the construction agency which took the lead or participated in project studies within the plan formulated for this report. Study responsibilities shown in Part V indicate one possible distribution of future construction planning and construction responsibilities. However, final decisions in that regard lie with the people in the areas to be served and with the Legislative and Executive Branches of the State and the Federal government.

Certain potential new projects could be constructed and operated by the private sector, by the Bureau of Reclamation, by the Corps of Engineers, or by the private sector in cooperation with either of those agencies. The projects involved include one small conventional single-purpose power project, proposed for long-range action, six long-range pumped-storage plants with an installed peaking capacity in the order of 23 million kilowatts, the recreation aspects of the proposed Fern Ridge Reservoir project modification, and any thermal power-generating plants. Decisions as to responsibility for such projects ultimately

will be made, perhaps on the basis of private-sector decision to proceed, as a part of the essential continuing coordination subsequently discussed.

The Task Force, in consideration of the nature of the projects included in the plan and of the overall responsibilities and capabilities of all those involved, concludes that the adoption of a suitable plan is more important that any present attempt to assign responsibility for plan implementation. However, subject to local, legislative, and executive concurrence at appropriate future times, implementation responsibilities might be:

Soil Conservation Service

All work under group enterprise activities, possible special legislation, and related programs, in cooperation with local sponsors as required by law, except as local-choice alternatives noted in Part V are involved. In those instances, the local people involved will have to evaluate the available alternatives and select the one most suited to their needs.

Bureau of Reclamation

All multiple-purpose storage and other works which would be integral basic elements of the Willamette River Project, Oregon, or the Tualatin Project. The projects involved are those presently being studied by USBR under existing legislative authorizations. With respect to local-choice alternatives shown in Part V, the local people involved will have the opportunity to choose the alternative they believe best suited to their needs.

Corps of Engineers

All multiple-purpose storage, other than those projects which would be basic elements of watershed or multiple-purpose reclamation projects; all works for navigation; the basin-system channel improvements; and all local flood control works, except those under Department of Agriculture projects and activities, would be by the Corps unless other considerations, as already mentioned, warrant change at the time when planning and construction would be done.

Private Sector

The nuclear- or fossil-fueled power-generating installations, recreation developments coordinated with agency plans, and a wide range of irrigation and other individual and group developments would be for private-sector development.

Unassigned

Those single-purpose projects for generation of conventional or pumped-storage hydroelectric power which could be constructed by the private sector, the Federal government, or by private-Federal cooperative action, and the diversion aspect of recreation at Fern Ridge Reservoir, are unassigned.

AUTHORIZATION AND APPROPRIATION

General

Actions leading to authorization and appropriation should be prosecuted at agency level according to normal agency procedures for reporting and budgeting. Projects in the early-action segment of the plan should be reported on, on the basis of continuing agency studies, and through normal channels, as rapidly as possible consistent with local desires and availability of funds, upon release of this report by the Pacific Northwest River Basins Commission. All authorizations resulting from such reporting should be followed by appropriate budgeting for planning and construction. Planning, funding, and construction of early-action private-sector projects also should be expedited, on a coordinated basis, if needs during the early-action period are to be satisfied. Programs in the plan should be the basis for immediate budgeting, at the levels indicated or as near thereto as would be consistent with pertinent budgeting policy. Proposed agency responsibilities are as shown above. Each responsible agency would have to use appropriate agency policy and guidelines as to budgetary procedure.

Preauthorization Costs

Early-action proposals include all of the programs and projects discussed in Part V under the early-action heading. Program elements generally can be implemented as soon as adequate funding can be provided.

Project elements, however, will require additional study before construction can be initiated. Such studies will be the basic responsibility of the Federal construction agencies, with appropriate State-level participation, but should receive continued coordinated funding, particularly for those storage sites which contribute to basin-system flood-stage reductions and/or low-flow augmentation. Because of the interdependence of those projects in satisfying in-stream flow requirements at key control points utilized in the hydraulic system analysis, it is essential, also, that consideration be given to their implementation on a coordinated and concurrent basis.

The costs and study requirements for the combined program-project proposals for the Department of Agriculture and the project proposals for the Corps of Engineers, Department of Army, and the Bureau of Reclamation and other Department of Interior agencies, together with associated State costs, are summarized as follows.

Department of Agriculture

The details of early-action proposals for which the Department of Agriculture will request authorization are contained primarily in Appendixes D - Fish and Wildlife, E - Flood Control, F - Irrigation, G - Land Measures and Watershed Protection, and M - Plan Formulation.

The first estimate of costs for the Department of Agriculture program in the early-action proposals is $76.8 million, of which $39.1 million would be provided by the Federal Government and $37.7 million would be provided by non-Federal interests. Estimated costs for the various elements of that proposal are as follow: (Note: An updating of costs to 1969 price levels would increase USDA early-action proposals to an estimated $96.9 million as indicated in tabulation footnote.)

Item	Estimated costs, $1,000,000		
	Federal	Non-Federal	Total
Small group jobs	3.9	3.1	7.0
Acceleration of ongoing land treatment programs 1/	2.2	2.1	4.3
Acceleration of National forest programs	6.3	-	6.3
Twenty-six small watershed projects	26.7 2/	32.5	59.2 2/
Totals	39.1	37.7	76.8 3/

1/ Outside of small watersheds.
2/ Includes $976,000 for preconstruction planning, with local sponsors.
3/ $96.9 million-1969 price adjustment - includes $1.2 million for preconstruction planning with local sponsors and $0.5 million for subsurface investigations.

USDA guidelines for Type II River Basin Studies require preparation of Watershed Investigation Reports for small watershed projects recommended for development within a 10- to 15-year period following the study. Twenty-six small watershed projects, including two which could be developed by alternative programs, are recommended for early development. Project proposals include planning and installation of land-treatment measures concurrent with the installation of structural measures proposed in Part V of this appendix.

Sixteen of the twenty-six projects include storage proposals with beneficial hydraulic effects to streams included in the basin system computer analysis. Additional studies in these projects should be coordinated with other agency storage proposals to realize full effectiveness of their potential for meeting downstream needs.

Since the enactment of P.L. 566, applications for small watershed planning assistance in the Willamette Basin have been received from 25 local sponsors. Planning is completed for eight of these projects and construction is in various stages of completion. A continuation of this rate of installation would require about 50 years to complete the early-action small watershed recommendations.

The normal procedure for authorization of small watershed projects under authority of P.L. 566 requires basically four steps which must be

applied individually to each watershed project: (1) submission of application by local ponsors; (2) a preliminary investigation to determine need and physical and economic feasibility; (3) authorization by SCS Administrator for completing the work plan; and (4) authorization by appropriate congressional committees for installing works of improvement contained in the work plan.

Investigations conducted during the course of the Willamette study were directed toward physical and economic feasibility analysis of structural measures and alternatives for the early-action watershed projects. The planning process is well advanced in a number of watersheds.

Sponsors of sixteen of these projects have applied for planning assistance - dating back to 1955. Sponsors in seven projects have additionally constituted themselves legally under state law to furnish the required non-Federal participation and assurances for planning and subsequent installation of projects.

Experience indicates a willingness by sponsors to legally organize and improve their priority position for limited planning authorizations. With seven such project sponsors now legally organized and awaiting approval for additional planning assistance, it would appear that some consideration should be given to a modified authorization procedure which would permit orderly completion of work plans followed by installation of works of improvements as sponsors became ready. Such a procedure could substantially eliminate the present backlog of unserviced planning requests and satisfy the 1980 projected need for watershed development.

The U. S. Forest Service, Department of Agriculture, also will participate in future studies of potential new projects which would be on National forest lands or which would affect management of forest lands or harvest of forest resources. Only a few of the early-action plan elements would entail participation, however, and then only to a limited extent. Thus the cost of Forest Service participation is estimated to be in the order of $10,000 to $15,000.

Department of Army

Early-action projects for which the Corps of Engineers, Department of Army, would seek authorization are described in Part V of this appendix. Included are new multiple-purpose reservoirs, a basinwide system of reservoir-associated channel improvements, separate multiple-purpose channel improvements, navigation improvements, and channel stabilization on uncontrolled streams. The estimated cost of those projects is in the order of $210 million.

Detailed preauthorization studies, based on and supplemental to data herein, will cost in the order of $800,000. Roughly 3 years will be required for completion of studies on each of the projects involved, but more than one study can be underway at any time, if funding will permit.

Department of Interior

As the major construction agency of the Department of Interior, the Bureau of Reclamation has the responsibility for investigating and seeking authorization of seven early-action projects described in Part V of this appendix. Included are two single-purpose irrigation projects and five multipurpose projects which include reservoir storage. Total estimated capital cost of those projects is about $495 million.

The seven projects are in various stages of investigation. Feasibility reports have been prepared for two; one report is in Washington awaiting congressional action and the other is in the final stages of the review process. Investigation costs required to complete feasibility studies necessary to bring the remaining five projects to the authorization stage are estimated at $2,415,000. This work has been tentatively programmed to be accomplished over the next 8 years.

Other Interior agencies also concerned with water and land resource development will be expected to furnish expertise in their particular fields as plans for the early-action projects are firmed up and made ready for authorization. They will be required to participate in formulation activities and in project evaluation and impact studies on projects of the Corps of Engineers and the Soil Conservation Service, as well as those of the Bureau of Reclamation.

The fish and wildlife agencies of the Department of Interior will be required to make extensive studies in connection with authorization of early-action projects and reauthorization of existing reservoirs to include the fish and wildlife functions. Investigation costs for the Bureau of Sport Fisheries and Wildlife are estimated at $525,000 and for the Bureau of Commercial Fisheries at $445,000.

Recreation studies will be carried out by the Bureau of Outdoor Recreation. An estimated $92,000 will be required to make the necessary studies on early-action projects and on existing projects for which reauthorization to include recreation is being considered.

Public lands administered by the Bureau of Land Management are affected both directly and indirectly by construction of reservoir projects. That agency will require about $60,000 to make impact studies on the early-action projects.

The Federal Water Pollution Control Administration is the agency responsible for water quality and municipal and industrial water supply investigations for Federal projects. Funds required to perform necessary studies for early-action projects and for the existing projects being considered for reauthorization are estimated to total $475,000.

Investigation of mineral deposits within proposed reservoir sites is a function of the Bureau of Mines. Mineral examinations of proposed early-action reservoir sites are estimated at about $24,000.

Development of new, extra-high-voltage transmission facilities necessary to provide the means for increased power imports and deliveries from new projects discussed in Appendix J, Power, and listed in Part V of this appendix, will be carried out by Bonneville Power Administration and the utilities serving the power loads of Willamette River Basin.

In summary, the agencies of the Department of Interior will require an estimated $4,036,000 in investigation funds. This amount would be adequate to complete studies prerequisite to authorization of early-action projects and for studies of those existing projects being considered for reauthorization.

State of Oregon

The fish and wildlife agencies of the State of Oregon also will have costs associated with implementation of early-action plan elements.

The Oregon State Game Commission has identified four principal areas where expenditures will be required. Those general areas are:

1. Make or complete the needed biological and related studies. The two Bureaus of the U. S. Fish and Wildlife Service will require $970,000 to make studies connected with authorization or reauthorization of early-action developments to include the fish and wildlife functions. The State fish and wildlife management agencies are obligated to devote much companion effort in all Federal fish and wildlife studies. The costs involved may not always equal the Federal costs, but frequently, except for report publication, even greater State effort is involved. Thus, roughly $1 million of State funds will be required in this area.

2. Continue and accelerate the programs involving acquisition of lands for public benefit as soon as the basin plan has been adopted. Both the Fish and Wildlife and Recreation Appendixes list very significant acquisition needs, with the cost of many properly being assigned to State programs. Specifically, the Game Commission should be involved in the game management and angler access areas. The total cost of these is not firmly established, but would be an impressive figure when considering State agency budgets.

3. Participation in the non-Federal cost sharing in Federal projects under Public Law 89-72. The early-action portion of the plan includes four Corps of Engineers and seven Bureau of Reclamation projects, all of which contain fish and wildlife and recreational features. One-half of the as-yet-unevaluated separable costs for these features would fall to the State and its political subdivisions. Early construction of most or all separable-cost recreation and fish and wildlife elements of those projects could impose impossible financial burdens upon the State agencies concerned. Consequently, future detailed planning must include careful evaluation of both the cost and timing of separable-cost features, so that the State agencies involved may plan to discharge the responsibilities involved.

4. Cooperation with the Soil Conservation Service in projects constructed under Public Law 566. Approximately the same situation exists in the development of the smaller watershed projects as under the cost-sharing requirements of PL 89-72. Thus, the same consideration

as for major projects must be given to establishing timing and amount of State participation in projects under PL 566.

Unless provision is made for identification of costs and for funding at State level for participation in those costs, it may not be possible to incorporate necessary features and facilities for essential functions in the projects proposed for early action.

CONTINUING COORDINATION

Coordination and cooperation among agencies, and between and among agencies, the public, and private-sector developers, must be continued during all phases of plan implementation. The Task Force sees neither necessity nor authority for its continuation as an entity. However, (1) each construction agency, in subsequent planning and construction; (2) each land and water management agency, in implementing program elements of the plan; and (3) each water- and land-related resource agency, in its day-to-day activities, should take the lead in coordination related to its activities and responsibilities. Further, a multi-agency-public coordinating committee should be established. That committee, as discussed in Part V text on recreation programs, should provide the coordination necessary to keep up-to-date the assignments of agency responsibility for development, and periodically review progress in achieving goals. In doing so, it should keep in mind projected and actual population increases, the possibility of private-sector participation, changes in technology as related to capabilities and alternatives for meeting needs, and any changes in agency capability on the basis of funding and/or laws and policies. Also, as discussed in Part V text, it should coordinate and expedite the implementation of the environmental management program. Leadership of the committee could be provided by the State of Oregon, the Bureau of Outdoor Recreation, or jointly by both.

As a basis for continuing coordination and cooperation, the Pacific Northwest River Basins Commission, upon adoption of the plan and release of this report, should publicize widely the existence of a basin plan for water and related resource development and use. It should make known, initially and as often as appropriate, the availability of this report and the coordinated and cooperative nature of the planning involved

in its preparation. It should publicly stress the necessity for each concerned individual, group, or entity to assist in coordinating any plan-related activity. Also, at appropriate times, it should mention and support the additional agency studies which will be prerequisite to recommendations for project authorization, so as to insure maximum public cooperation in and input to those studies.

LEGAL, INSTITUTIONAL, AND OTHER CONSIDERATIONS

Certain of the problems discussed in Part III must be resolved as soon as possible if the viability of the plan presented herein, and of the institutional arrangements on which that plan will depend, is to be preserved. Included in that category are the following.

State of Oregon

The State of Oregon should move to consider the entire question of Federal requirements for project sponsorship. The State's position with respect to providing or facilitating the provision of sponsorship should be determined. If the State of Oregon wishes to be able to provide sponsorship for projects of a nature or magnitude which renders local sponsorship difficult at lower governmental levels it should take appropriate action. Alternatives include, but are not necessarily limited to, those mentioned in Part III.

Adjudication of all water rights and claims is essential. Without such adjudication, all unadjudicated rights upstream from Willamette Falls will remain under a cloud. Also, and critical from the standpoint of viability and validity of the plan formulated herein, the assumption made as to availability of natural flows must be confirmed or corrected at the earliest possible date.

In view of the projected tremendous increase in electric power demands, and the consequent need for development of thermal generating plants, the State should move immediately to establish a thermal plant siting entity. Without an entity which can make, and enforce, siting decisions the substantial water needs and potential environmental impacts of thermal installations cannot be considered appropriately in subsequent studies essential to plan implementation.

Federal

The problems of local sponsorship for which State of Oregon action is suggested in immediately preceding text stem both from existing Federal requirements and Federal policy as to application of those requirements. The Task Force concludes that no significant change toward reduction or elimination of any of those legal requirements is foreseeable. However, it concludes that consideration should be given, at agency and departmental levels, to the question of "assurances" of intent to cooperate in, or sponsor, projects as discussed in Part III.

With respect to the sponsorship requirements of the Federal Water Projects Recreation Act, Public Law 89-72, the Task Force concludes that the Federal planning and construction agencies must recognize: (1) the limitations on fiscal capability of potential non-Federal sponsors, (2) the relative magnitude of projected recreation and fish and wildlife needs, and of potentials for meeting those needs. It concludes that Federal planning agency actions in subsequent studies should be such as not to preclude or tend to preclude full preservation, and ultimate development and use, of available potentials in those fields.

Further, the Task Force concludes that Public Law 91-190, the National Environmental Policy Act of 1969, sets the stage for needed and appropriate consideration of both: (1) the untouched natural aspects of Willamette Basin environment, and (2) the overall environment in which basin residents live their day-to-day lives. It concludes that both those aspects of environment must be considered and integrated into all future planning, on the basis of coordinated action between and among planning and construction, resources, and environmental agencies and interests.

FUNCTIONAL CONSIDERATIONS

Plan formulation has given considerations to present and projected needs in each of the functional fields now recognized to be appropriate to Federal projects and programs. It has considered all of the known resources and potentials which could be controlled, developed, used, or preserved to meet those needs. It has covered the possibility of non-Federal agency and private-sector actions to meet portions of the projected needs.

The Task Force concludes that the resulting comprehensive basin plan is practical and appropriate, and that it would provide a high level of service to each of those needs in the foreseeable future.

FISH AND WILDLIFE

Both fish and wildlife would feel the effects and impacts of projects and programs in the comprehensive plan. Appendix D, Part V, contains specific recommendations of the Fish and Wildlife Committee. Those recommendations are for minimizing detriments, maximizing enhancement aspects, and mitigating unavoidable losses.

The Task Force concurs with those recommendations. Also, it concurs with an earlier statement of the Senate Select Committee on National Water Resources, in Committee Print No. 18 pursuant to Senate Resolution 48 of the 86th Congress. That statement is paraphrased and expanded as follows, with respect to Willamette River Basin: Fish and wildlife resources are both an important element in the overall environment of the basin and one of the important bases of one of its fastest-growing industries--outdoor recreation. Of even greater importance, fishing and hunting, along with other outdoor activities, are recognized medically as having great therapeutic values in the release of stresses and strains caused by the rapid pace of modern life.

The enhancement of fish and wildlife resources should be furthered by program continuation and acceleration. It should be made a function of each project, to be served to the maximum extent consistent with project capability, economic feasibility, and overall requirements for service to all needs. Additional studies of individual projects and the overall system of major reservoirs must be supplemented by more detailed information on optimum flows and water quality for fish. Those

studies must show, in detail, how projects would be planned and operated to take advantage of opportunities for fish and wildlife enhancement and the resulting benefit to the resource.

The Task Force further concludes that evaluation studies should be made, as rapidly as consistent with early-action plan implementation, of overall plan effects on anadromous fish. Such studies would be essential to: (1) confirm the optimistic view of the fishery agencies as to potentials for enhancement; and (2) provide a basis for any needed adjustments and refinements to program activities, storage project operational procedures, fish-production plans as mitigation for project impacts, or any other fishery aspect of overall plan elements.

FLOOD CONTROL

The flood control effects of structural measures such as those proposed herein have been demonstrated widely and often, both within and outside the basin study area. Experience has shown that storage control will reduce flood stages and the extent of the flood plain over a wide range of flood magnitude, and thus permit safe use of a larger land area. Experience throughout the Nation also has shown that stage reduction alone will reduce the ultimate level of damages but little. This has been true because of the combination of less-than-complete control of floods and lack of regulation of flood plain use. Under those conditions, development encroached into remaining flood plains to an extent which almost duplicated the potential for damages which existed before structural control was exercised.

The Task Force concludes that complete control or confinement of flood flows is neither physically practicable nor economically justifiable. Thus, prevention of future increases in flood damage cannot be accomplished by structural means alone. It concludes that local (City, County, and/or State) action to regulate use of and developments in the remaining flood plain would be an essential element of additional work for flood damage reduction, and compatible with the environmental management program. It notes that information on extent and degree of flood hazard, and on means of floodproofing developments in the flood plain, is available under programs described herein. Also, it notes that the State has moved to obtain appropriate land use zoning. It concludes that construction of new (presently unauthorized) projects

having a flood control function should be contingent on appropriate local assurances that adequate flood plain use regulations would be adopted and enforced. Such assurances would have to be furnished by a legally constituted entity, or combination of entities, of local government having jurisdiction over all pertinent areas and authority to make binding commitments. The Task Force concludes that such local regulation, adopted when the first increment of structural flood control is constructed, should be flexible. Modifications, in consideration of additional protection provided and actual operating experience, should be made as additional increments of structural protection become available.

A further consideration, from the flood control standpoint, is the apparent need for additional action at State level to facilitate the formation of adequate non-Federal sponsoring bodies. Such bodies are required, under Federal flood control law, to provide assurances of cooperation in projects for flood control and to carry out those assurances. Projects involved include some now authorized and all potential new local projects which would not be parts of small watershed development or the basin-system channel improvement project. As noted in Part III, problems have been experienced at local level, both in the formation of a sponsoring body and in the subsequent discharge of maintenance responsibilities.

Project sponsorship by the State, a county or counties, or by an organization representing a complete watershed or basin, would eliminate most of the problems experienced to date. The Task Force concludes that appropriate non-Federal action would be to either (1) amend the State Constitution to permit project sponsorship at State level, or (2) adopt legislation to further facilitate the formation of sponsoring bodies which would represent complete watersheds or basins, and which would have greater ability to carry out the responsibility of sponsorship.

The Task Force further concludes that the system nature and effects of existing channel stabilization works on reservoir-controlled streams warrant further consideration of local participation requirements with a view to insuring equity and uniformity for those works and proposed new basin system channel works. It also concludes that further study should be made of operating schedules for existing reservoirs with a

view to possible increased filling capability, particularly for projects such as Fern Ridge Reservoir with low-elevation watersheds.

IRRIGATION

A considerable amount of irrigation development by individuals and by group effort is anticipated. Also, because of the location of large areas of land relatively remote from adequate water supplies, large Federal irrigation developments will be required. Some of those developments would use stored water from existing and authorized Federal storage. Some would use water from proposed new Federal storage. In certain instances, the landowners involved would have a choice to make between alternative sources of supply. In some instances, the choice would be between use of existing Federal storage and development of small watershed project storage with irrigation as a function.

In these areas, the Federal agencies involved should provide adequate information on the costs, the effects, and the impacts of the alternatives as basis for local decision. The Task Force concludes that any loss of potential irrigation reimbursement of sunk costs resulting from local choice to develop new storage, in lieu of using existing Federal storage, must be considered. However, the Task Force recognizes that none of those existing Federal projects have entailed specific increments of expenditure for irrigation; the available irrigation supply shares joint-use storage space with flood control. Further, alternative beneficial uses may exist for such joint-use Federal storage not used for irrigation and this should be given full consideration. Those alternative uses include reservoir fishery and recreation, and/or fish life, pollution control, navigation, water supply, and recreation benefits from downstream flow augmentation.

A considerable portion of the total irrigable area in the basin is so located that a supply of stored water could be provided from one or all of several upstream reservoirs constructed by the Corps of Engineers. Under Federal reclamation law, storage costs allocated to irrigation are reimbursable, without interest, up to the irrigator's repayment capacity. Costs in excess of repayment capacity are the subject of financial assistance arrangements, under PL 89-448, as amended. Data now available indicate that payment for irrigation water probably will

be on the basis of repayment capacity within each irrigation project area, rather than allocated cost.

There is a need for the agencies involved, the Corps of Engineers and the Bureau of Reclamation, to complete a cost allocation for all of the storage involved and considering all functions to be served under the plan. From that allocation they should develop a "postage stamp," or uniform, rate for the cost of storage for irrigation and other reimbursable uses. This would establish known values for stored water and facilitate use of storage to the best advantage for all concerned.

A further consideration of particular importance to irrigation is the need for adjudication of all water rights and power claims, as discussed in Part III. The Task Force concludes that the State should give high priority to early completion of the adjudication program now underway for all streams in the basin study area. All unresolved water rights questions are significant but the power claims at Willamette Falls, for far more than the natural low-water flow, cast a cloud over all upstream consumptive uses and users.

MUNICIPAL AND INDUSTRIAL WATER SUPPLY

Based on capabilities of storage elements of the plan, and on the general levels of availability of surface and ground water, an adequate supply for all future demands appears to be available. It appears, however, that many users may find it economically desirable, or even necessary, to use sources such as Willamette River which are of quality lower than those presently in use. Public acceptance of such sources has been limited in the past. The Task Force concludes that the State Board of Health and Office of Public Health Engineering; the U. S. Public Health Service, Bureau of Water Hygiene; the FWPCA, and the State's Department of Environmental Quality should participate in continuing planning for appropriate aspects of water supply. In so doing, they should stress, at all appropriate public occasions, the availability and capability of currently available purification techniques. Also, there probably will be a considerable need, on the part of many municipalities, for financial assistance in providing the needed treatment and purification facilities.

The Water Supply Act of 1958 (Title III to Public Law 85-500), as amended, requires that costs allocated to municipal and industrial water supply be repaid, with interest, by the user. As was discussed in connection with irrigation, many potential users could be served from one or all of a number of reservoirs. In consideration of that fact, the Task Force concludes that subsequent detailed agency studies should lead to establishment of a basin-wide, uniform cost of storage for M&I water, the same as for irrigation. Such a cost should include the allocated M&I storage costs for all major reservoirs, except possibly the Scoggins Creek Reservoir, for which water supply is a specifically authorized function and storage is allocated to specific users, and possibly those for smaller reservoirs in watershed projects.

NAVIGATION

Navigation aspects of the plan, involving both flow augmentation and open-channel works, are only partially formulated. Thus, specific conclusions cannot be drawn. However, there would be beneficial multiple-use aspects of both flow augmentation and the major reservoirs which would provide augmentation. Also, there would be detrimental aspects involved in any considerable amount of channel dredging, either for construction or for annual maintenance of a channel. Thus, the Task Force concludes that, in connection with completing navigation plan formulation, full consideration should be given to the possible availability of additional stored water for flow augmentation.

POWER GENERATION

Except for the existence of sites for potential major pumped-storage installations, as a source of peaking capacity, the multiagency study has revealed relatively little additional hydro-power potential in the basin. Thus, basin energy needs would have to be met by importation of power and by nonhydro development.

If public acceptance of thermal generating plants should permit such installations in the future, there may be a very large demand for cooling water. Future planning for long-range projects should consider that possibility.

Pumped-storage plants would have to operate in conjunction with some other source--possibly nuclear-fueled thermal plants--of off-peak period energy for pumping. A very large amount of additional capacity, up to a total in the order of 23 million kilowatts, could be developed at pumped-storage sites included in the plan. Such an increment would be of considerable value in meeting demands on the Pacific Northwest power grid. However, there are serious potentials for adverse environmental, fish and wildlife, and recreation impacts. Also, there are other locations, in the Columbia-North Pacific Region, which offer significant potential for even larger pumped-storage installations, some with no apparent potential for adverse environmental impacts.

The Power Committee concluded that potential pumped-storage projects would be appropriate long-range elements of the basin plan. At the same time, it concluded that development of those sites must be preceded by exhaustive coordinated and cooperative study to show how pumped-storage could be fitted into the regional load pattern. The water pollution control agencies have concluded that study must be made to show how those sites could be fitted into the overall basin water management program. Such studies, in total, would show which sites, on a regional basis and considering location and extent of thermal installations, base-load hydropower, and water management needs, should be given highest priority. The Task Force concurs with those conclusions.

RECREATION

Appendix K, Part V and Addendum A, contains general and specific conclusions and recommendations by the Recreation Committee. Included are recommendations for development and for preservation. In addition, the Committee has made certain specific recommendations for environmental preservation which are shown in Addendum E to this appendix.

The Task Force generally concurs with those recommendations. It concludes that the comprehensive basin plan embodies an optimum overall combination of features for development, including recreation, and preservation. It concludes that there is a need for further study and research covering the entire field of recreation as related to environment. There is a need for agency-public coordination and participation in such study. The proposed multiagency-public committee, mentioned

earlier in connection with recreation and environmental management, could become the coordinating entity. The Task Force also concludes that particular attention should be given to the as-yet-unevaluated recreation aspects of flow augmentation. Such studies should provide a basis for determining the net value of flow augmentation, including consideration of multiple benefits downstream and the effect of storage withdrawals on reservoir recreation and fishery benefits.

WATER POLLUTION CONTROL

The Task Force concurs in the overall conclusions of the Water Pollution Control Committee, as shown in Part V of Appendix L. It concludes that water quality improvement should be an authorized purpose of each reservoir project, and particularly of those which can be operated for major flow augmentation. It recognizes that the degree of justifiable flow augmentation is a function of both the degree of waste treatment provided and the overall stream conditions in each year. Thus, it concurs in the Committee's conclusion that the need for flow augmentation not only will increase, but will vary from year to year. New authorizations should provide for coordination between and among reservoir operating, water quality, fishery, and recreation agencies in determining annually an appropriate degree of, and schedule for, flow augmentation.

Further, the Task Force recommends that, in subsequent agency studies of individual major storage projects, consideration be given to provision of multilevel withdrawal facilities to permit selection of water of the temperature most suitable for release into the stream. Attention should be given to the possibility that reaeration of such releases might be needed, and appropriate allowance for possible future installation should be made.

In addition, the Task Force recommends that major storage project authorizations and project costs include provision for carrying out post-construction studies and evaluations of project effects on water quality. In the event of any project-caused quality problems, such studies should include analysis of possible corrective actions.

OTHER CONSIDERATIONS

In addition to the specific functional considerations for which discussion and conclusions are shown in preceding text, the Task Force recognizes the importance of certain other considerations. Those considerations relate to plan formulation and to nonfunctional and multi-functional plan elements.

PLAN FORMULATION

When the study was initiated the Task Force envisioned, and had as a goal, the completion of studies in sufficient detail to support specific recommendations for program and project authorizations. Experience as the study progressed, however, showed an inability on the part of concerned agencies to accomplish programmed studies on schedule. That inability stemmed from many factors, including funding imbalances among agencies, both in amount and timing: overall staff capabilities as related to assigned workload; and, in some cases, agency policy. Thus, slippages and losses of time in sequential operations were compounded. As a consequence, the study was neither completed on schedule nor in as much detail as originally planned.

As presented herein, the study shows the plan formulation steps and presents rationale for the plan so formulated. Early-action plan elements were shown to be economically feasible at the 3-1/4 percent interest rate in use until 1969. At the 4-5/8-percent rate adopted at that time, the excess of benefits over costs is reduced but prospects for economic justification remain good.

The effects of further increases in interest rate and of possible new guidelines on benefit analyses, which probably will increase benefits, remain to be evaluated in subsequent agency studies. Those studies must provide appropriate coverage of project sizing, net benefit maximization studies, and cost allocation. They should be accompanied by continued coordinated study, on the part of the resource agencies of: (1) specific flow and temperatures for fish life, (2) overall water quality needs, and (3) potentials for downstream benefits attributable to increased flows and improved water quality. Those studies should be coordinated with individual project and system studies to provide an improved evaluation of needs, and the benefits available and creditable

to individual projects. All other potential project functions should be the subject of additional studies, as appropriate, aimed at refinement of needs and benefit data as a basis for more detailed formulation studies.

Subsequent agency studies should give full consideration to inclusion in individual project plans of provisions for as many of the recognized functional and environmental needs as are justifiable. Specifically, coverage must be provided for environmental matters as stipulated in Public Law 91-190, the National Environmental Policy Act of 1969. Such studies, and the resulting reports, should give recognition to and make recommendations for use of existing and authorized projects to serve needs not recognized in present authorizations. Also, Corps of Engineers studies should explore, in more detail, the possibility of modified operating schedules to facilitate annual filling of storage space. This would be particularly important on west-side tributaries, where filling depends on rainfall.

LAND MEASURES AND WATERSHED PROTECTION

These program measures are multifunctional. They would help to keep basin lands ready to meet the demands of rapidly growing population and changing land use. Soil losses would be held to a minimum, and water quality would be improved for all uses. The damaging effects of floods on the watersheds would be ameliorated. Overall environment would be improved. The Task Force concludes that these measures, as detailed and recommended in Appendix G, should be put into effect, or accelerated, as soon as possible.

ENVIRONMENTAL MANAGEMENT

This proposed new program would meet needs related to the well-being-of-people objective as well as contributing to fisherman, hunter, and recreationist success and enjoyment. Costs for implementation apparently would be minimal. Under the flexible management concept proposed, future development opportunities would not be lost unless further studies as proposed showed that environmental losses would outweigh the loss of development opportunity.

The Task Force concludes that a flexible management program, as proposed, is an essential plan element. It should be put in operation, without delay, on public lands. Private landowners should be encouraged

to take consistent actions on their holdings. The proposed studies of all values present in areas under the program should be expedited to provide a basis for reasoned choices and decisions in the future. Such studies, noted in Part V, should be compatible with, and assist in providing data called for by, Public Law 91-190 in connection with reports recommending project authorization and construction.

STREAMFLOW FORECASTING

The multifunctional streamflow forecasting program is essential to project operation for flood control; for the continued health, safety, and welfare of the public; and to many industrial operations. It should be continued and expanded as proposed.

RADAR WEATHER SURVEILLANCE AND PRECIPITATION DATA REPORTING NETWORK

These programs provide essential support for the multifunctional streamflow forecasting program, and should be continued for that purpose. The precipitation data reporting network should be expanded consistent with the rate of planning for and construction of new projects which will utilize streamflow forecasts as an operational tool.

AIR POLLUTION CONTROL SUPPORT

This program would be an essential element of the plan for preservation and enhancement of the overall environment of the basin. It should be supported, expedited, and updated as dictated by operating experience.

SEASONAL AND RESIDUAL WATER SUPPLY FORECASTS

This program is needed and used by farmers and other water users to assist in planning annual operations. Particularly in view of the projected increases in irrigation and other demands for water, it should be continued, and expanded to provide additional irrigation supply and low flow forecasts.

MAPPING

All planning and construction agencies, and many industries, groups, and individuals must relay on up-to-date and accurate mapping as a basis for planning. Completion of the present program of coverage in the 7-1/2-minute series, with contour interval of 5 or even 2 feet

in flat areas, should be expedited. Also, soil mapping needed for detailed planning should be continued, and consideration should be given to adoption of a coordinate system for data retrieval and property description purposes.

SUMMARY RECOMMENDATIONS

The Willamette Basin Task Force recommends the adoption of the comprehensive basin plan as described in Part V text and summarized in Tables V-1, 2, 3, and 4; further summarized in Table VI-1; and qualified by conclusions herein. It recommends that, as soon as the plan is adopted and this report is released for agency use, steps be taken to implement the early-action proposals. Such steps must include adequate replacement and/or restoration of fish and wildlife habitat and fish which would be lost incidental to project construction and operation. Agency responsibilities for program and project implementation could be as shown in Part V, or could be modified on the basis of local desires and other considerations pertinent at the time, consistent with conclusions earlier in this section of Part VI.

Plan implementation, in all stages and by all agencies, must be done on a coordinated and cooperative basis, involving the public as well as agencies. It must include functional considerations shown in pertinent functional appendixes, as modified and combined in plan formulation and conclusions presented herein.

The Task Force recommends that subsequent formulation studies give full consideration to maximizing multiple-purpose aspects of each project. This would include, particularly, those aspects related to overall environment and quality of life and those related to fish and wildlife enhancement and recreation in a desirable setting. It recommends that the results of such multiple-purpose considerations be incorporated in agency reports and confirmed by appropriate project authorizations and reauthorizations, to provide formal recognition of purposes to be served.

The Task Force recommends that all program elements of the plan be continued, accelerated, and/or initiated as proposed in Part V. Steps leading to implementation of recommended acceleration and initiation should be undertaken as soon as the basin plan has been adopted. This would be particularly important with respect to: (1) the environmental management program, (2) those program activities which involve acquisition of lands for the public benefit, (3) the streamflow forecasting and related programs, (4) the air pollution control support program,

Table VI-1

Summary 1/ of the comprehensive plan

Plan Element	Plan Costs, $1,000,000 2/ Base 3/	Early-action	Long-range	Totals
Programs:				
Functional	56	255	759	1,070
Other	N/A	21	68	89
Totals	56	276	827	1,159
Reservoirs 4/	566	352	186	1,104
Nonstorage projects	66	343	220	629
Power projects:				
Thermal	N/A	-	400	400
Hydroelectric	N/A	-	2,454	2,454
Totals	N/A	-	2,854	2,854
Total plan costs	688	971	4,087	5,746

1/ From Tables V-1, 2, 3, and 4.
2/ To the extent identified.
3/ Includes existing, authorized, and assured.
4/ Including associated hydroelectric power-generating installations.

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and (5) those study and research activities related to future planning and decisionmaking.

The Task Force further recommends that, at both State and Federal levels, consideration be given to analyzing and resolving the legal and institutional problems discussed in Part III. Those actions must be accomplished as soon as possible if the viability of the plan presented herein, and of the associated institutional arrangements, is to be preserved.

Finally, the Task Force recommends that consideration be given to timely completion of ongoing agency studies, and to planning for future review and updating of the comprehensive basin plan. Such planning should be initiated immediately, in considerations at agency and departmental levels, in cooperation and coordination with the Pacific Northwest River Basins Commission and the Water Resources Council. Among other factors, consideration should be given to improving methods for coordinated accomplishments of review and updating studies, so as to increase efficiency and avoid delays and deficiencies recognized in this study and report.

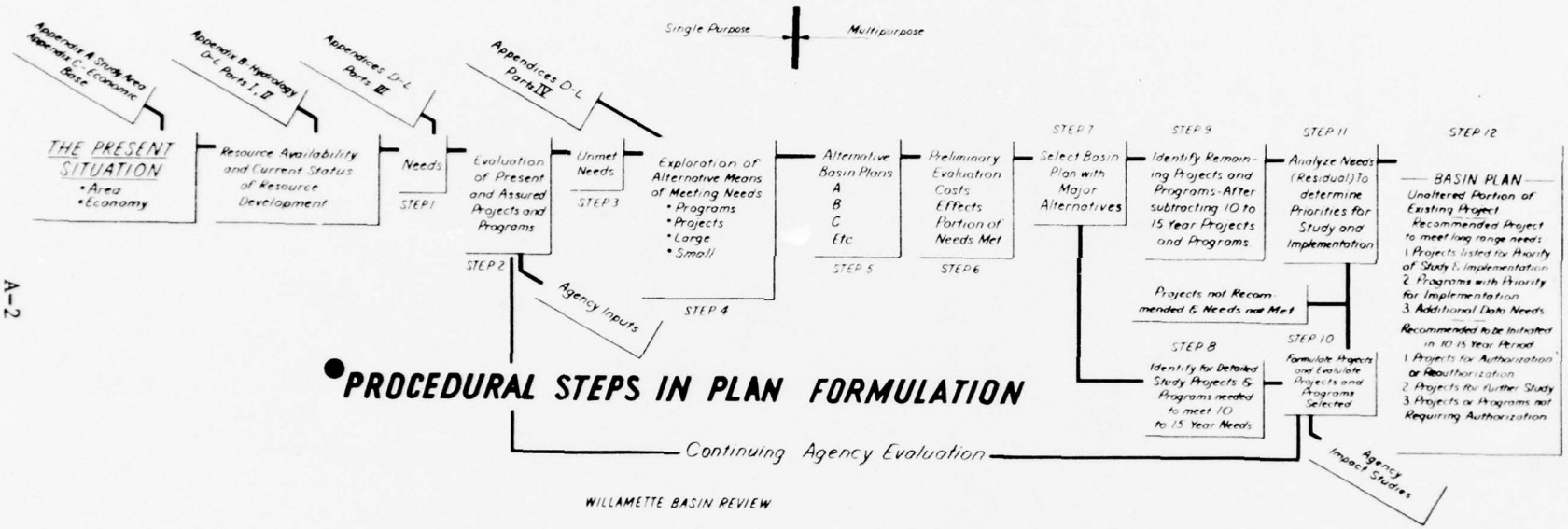
ADDENDA

A D D E N D U M A

PLAN FORMULATION PROCEDURE

On 16 October 1966, the Task Force presented to the Columbia Basin Interagency Committee, the predecessor of the Pacific Northwest River Basins Commission, a summary of plan formulation procedures developed for this study. Based on approval received from CBIAC, the Task Force then prepared a detailed procedural guide, which was published and copies furnished all cooperating agencies. Copies of that publication are available in the offices of the PNWRBC.

The following chart summarizes and shows relationships between each of the 12 steps involved in that procedure. As noted in Part IV, the procedure actually followed for this study was a composite (over time and often repetitive as data became available in increasing detail) of those 12 steps.


Single Purpose
Multipurpose
Appendix A Study Area Appendix C Economic Base
Appendix B Hydrology D-L Parts I, II
Appendices D-L Parts III
Appendices D-L Parts IV
THE PRESENT SITUATION
• Area
• Economy
Resource Availability and Current Status of Resource Development
Needs
STEP 1
Evaluation of Present and Assured Projects and Programs
STEP 2
Agency Inputs
Unmet Needs
STEP 3
Exploration of Alternative Means of Meeting Needs
• Programs
• Projects
• Large
• Small
STEP 4
Alternative Basin Plans
A
B
C
Etc
STEP 5
Preliminary Evaluation Costs Effects Portion of Needs Met
STEP 6
STEP 7
Select Basin Plan with Major Alternatives
STEP 9
Identify Remaining Projects and Programs - After subtracting 10 to 15 Year Projects and Programs
STEP 11
Analyze Needs (Residual) To determine Priorities for Study and Implementation
STEP 12
BASIN PLAN
Unaltered Portion of Existing Project
Recommended Project to meet long range needs
1. Projects listed for Priority of Study & Implementation
2. Programs with Priority for Implementation
3. Additional Data Needs
Recommended to be Initiated in 10-15 Year Period
1. Projects for Authorization or Reauthorization
2. Projects for further Study
3. Projects or Programs not Requiring Authorization
Projects not Recommended & Needs not Met
STEP 8
Identify for Detailed Study Projects & Programs needed to meet 10 to 15 Year Needs
STEP 10
Formulate Projects and Evaluate Projects and Programs Selected
Agency Impact Studies
PROCEDURAL STEPS IN PLAN FORMULATION
Continuing Agency Evaluation
WILLAMETTE BASIN REVIEW

A D D E N D U M B

LIST OF PUBLIC HEARINGS AND SUMMARY OF TESTIMONY

As a prerequisite for coordinated agency-public cooperation on the study, the Task Force held a series of four public hearings in 1963. Dates and places were:

Date	Location
April 2, 1963	Eugene, Oregon
April 4, 1963	Albany, Oregon
April 9, 1963	McMinnville, Oregon
April 11, 1963	Oregon City, Oregon

Testimony presented at those hearings showed a growing public awareness of needs in each functional field, of the significance of a desirable environment, and of problems related to conservation and wise use of resources. A summary of the testimony presented follows:

Flood control and drainage - Existing storage projects, channel improvements, and drainage facilities have reduced both the frequency and severity of flooding in certain areas, but there is a substantial remaining flood problem. People living near west side tributaries such as Marys River, Luckiamute River, Yamhill River, Tualatin River, and along portions of Willamette River reported serious flooding varying in frequency from occasional to as often as 15 times a year. A number of hearing participants reported serious bank cutting and erosion due to streams being held at bankfull stage to evacuate storage reservoirs prior to expected heavy runoff. Many people expressed a need for channel clearing and alignment to reduce flooding. Drainage problems were reported throughout the basin's low-lying areas.

Irrigation - Residents expressed need for additional water for irrigation of new lands and also for supplemental irrigation in water-short areas. These needs were generally from people living in the west side subbasins where there is little storage or summer natural flow, and those portions of the east side subbasins and Willamette River where pumping storage releases was not considered economical or practical. There were a number of areas where the lack of irrigation water was reported to limit the expansion of irrigation.

Power - Several hearing participants pointed out that Willamette Basin would continue to be an importer of power. They added that a need existed for both base power development and peaking power. It was recognized that little potential remains for base power development at hydro sites, but there is a potential for hydro-peaking plants, including pumped-storage plants, to supplement existing power development, imported power, and anticipated thermal power.

Navigation - Representatives of several towing companies expressed a need for replacement of the existing locks at Willamette Falls which were reported to seriously restrict navigation. A need for deepening the channel in the reach above the falls to Corvallis was also presented.

Fish & Wildlife - People reported a desire for better access to streams for fishing; for improved fish habitat through increased flows; for reduced water temperatures; for additional hatcheries; for removal of scrap fish; for improved fish passage facilities; and for general improvement of the fishing resource.

Wildlife needs were for improved habitat, development of new habitat, and most often for maintenance of the existing habitat.

Municipal and Industrial Water Supply - The major problem or need expressed related to the smaller cities and communities where present water supplies were inadequate or where the source was expected to prove inadequate in the future. Many people expressed concern over both quantity and quality of ground water for domestic and municipal purposes.

Recreation - Hearing participants expressed needs for greatly accelerated development of recreational facilities to overcome both present shortages and anticipated future shortages. There were many expressions of need for additional water surface area particularly on the west side tributaries and near the Portland metropolitan area.

Water Pollution Control - There were expressed needs for improved treatment of wastes, increased flows for improvement of quality, control of erosion, combining of waste treatment facilities in expanding suburban areas, control of wastes to the ground water, reduction of water temperatures, and improved industrial treatment.

Watershed Management - There were a great many expressions of need for improved drainage, erosion control, and programs to increase productivity of agricultural and forest lands.

Environment - Many basin residents expressed a concern regarding the total environment. Increasing population and accelerating municipal and industrial development threaten the natural conditions which residents have long cherished.

A D D E N D U M C

INVESTIGATION PROCEDURES AND PROJECT STUDIES

General

This addendum discusses the investigation procedures employed in this study by the State of Oregon and the Federal construction agencies. It summarizes, for each Federal construction agency, information on their overall project investigation programs for the comprehensive study conducted in accordance with those procedures. In addition, some data are presented on potential nongovernmental development.

State of Oregon

Shortly prior to and during the first 2 years of the Willamette Basin Comprehensive Study, the State Water Resources Board conducted investigations in Upper, Middle, and Lower Willamette River Basins (subareas in the Comprehensive Study). Reports recording those studies provided the basis for the board's programs (water resource policy statements) governing the use and control of the basin's unappropriated waters.

Prior to publishing a summary report on the entire basin, during the 1965-67 biennium, the board conducted a review study in which emphasis was placed on identifying water-resource problems and needs. In addition to extracting problem-related data from transcripts of public meetings, including a 1964 statewide water conference held during the earlier studies, direct contact was made with other State agencies, county courts, county extension agents, county and municipal planners, private industry, utilities, and banking institutions. The detailed problems data were summarized, tabulated, and copies given to the Outline-Schedule Team, forerunner of the Willamette Basin Task Force Technical Staff.

As the study progressed, the construction agencies (Corps of Engineers, Bureau of Reclamation, and Soil Conservation Service) moved more deeply into exploring and planning for projects to meet the needs of the basin. The State, not being design and construction oriented, moved forward in tabulating and analyzing local, State, and Federal agency program activities and coordination related to developing the

basin's water and related land resources. Through that team approach, the capability of each participating agency was utilized where it best could contribute to the comprehensive study.

U. S. Department of Agriculture

Procedures

The USDA planning staff made use of information and data available from the Oregon Conservation Needs Inventory (CNI) which was published in 1962, and from each of the Type IV studies covering the Upper, Middle, and Lower subareas of the Willamette. Information from the Type IV studies, which were initiated in 1961 and carried out cooperatively with the Oregon State Water Resources Board, was consolidated and published in 1964 for interim use of the USDA staff and other study participants.

As a first step in the comprehensive study, the USDA planning staff reviewed the land-use and water-related-problems information for each of the 126 CNI watersheds comprising Willamette Basin. Each of the watersheds then was placed in one of three categories according to future development possibilities under the Watershed Protection and Flood Prevention Act, Public Law 83-566. The most important of the factors influencing this grouping were: (1) the extent and severity of the problems-- watershed protection, flood prevention, drainage, and irrigation; (2) availability and location of potentially suitable structural sites; and (3) apparent economic feasibility.

Next the groupings were reviewed with field office personnel. Knowledge of local interest was considered in a further refinement of the groupings. Concurrent with that step, the Oregon Association of Conservation Districts designated a special subcommittee to assist and advise the USDA planning staff in the setting of priorities for more detailed watershed investigations.

The subcommittee conducted a series of meetings throughout the basin. Local organizations were informed of study objectives. Views on resource problems, needs, and potential solutions were exchanged, and alternative approaches to resource development were presented. The USDA planning staff, as well as other planning agencies, were invited to participate in each of those meetings.

Over a period of about 3 years, there evolved from the meetings a much better assessment of not only the needs for project development but

of the willingness and ability of local groups to provide the necessary sponsorship. The watershed groupings were revised accordingly. More detailed watershed investigations were made for those areas with acute problems and active local sponsorship. The more detailed investigations were based on guidelines contained in SCS River Basins Memo 10, "Type I and Type II Comprehensive River Basin Surveys," June 1965 and River Basins Memo 12 "Guidelines for the Preparation and Content of Basin Investigation Survey Plans and Reports," September 1965.

Field investigations were made to supplement existing data. The planning staff met with local contacts to further discuss watershed problems, obtain local opinions, and develop planning objectives. Hydrologists and economists worked closely with local farmers and agricultural workers in delineating maximum and annual flood plains and in determining land use, crop distribution, and yield data for evaluating flood-damage-reduction, irrigation, and drainage benefits. Engineers conducted additional low-to-medium-intensity field surveys to supplement existing information and provide representative data for preparation of preliminary designs and cost estimates.

Watershed Investigation Reports (WIR's) were then prepared for the most urgently needed projects. Included in the WIR's is a description of the watershed--its location, climate, land and water resources, resource problems, needs, and development potentials. Expressions of local citizens strongly influenced the formulation of project measures for meeting local land treatment, flood prevention, irrigation, and drainage needs. Costs were allocated to purposes in accordance with PL 566 procedures. Recreation use rates were interpreted from information provided by the Recreation and Fish and Wildlife committees as well as from experience on similar projects in the basin. Storage of M&I water supply and downstream releases for fish, recreation, or water quality was included in some projects where potential existed but specific needs were not known or identified.

The monetary analysis included in the WIR's was based upon the 3-1/4-percent interest rate. The December 1968 Water Resources Council directive establishing the 4-5/8 percent project evaluation rate did not permit time for a complete analysis of all projects; however, the impact on benefit-cost ratios is available for each of the Watershed

Investigation Reports.

The joint inventory of potential dams and reservoirs carried out by the Corps of Engineers, Bureau of Reclamation, and the Soil Conservation Service proved to be one of the most useful pieces of information available from the study on which local leaders could begin to formulate ideas and make decisions. The Soil Conservation Service (SCS) investigated approximately 325 sites, most of which were of less than 50 square miles of contributing drainage area and less than 25,000 acre-foot gross storage capacity. Map or reconnaissance level survey data were utilized in developing area capacity curves and embankment volumes. Field inspections were made to record improvements and developments in the reservoir area and to aid in preparation of surface geology reports. Preliminary costs were developed for each site.

The storage proposals embodied in PL 566 projects recommended for early action resulted from the best matching of either or both conservation and flood detention storage requirements with locational needs, costs of development, and (to the extent possible) the preferences of local landowners and potential sponsors.

Sites included in the long-range potentials include: (1) the alternative sites considered but not proposed for early action in the PL 566 recommended projects and (2) those judged by the USDA planning staff to have the best capability for meeting future needs of flood prevention and conservation storage. Local preferences were not a factor, however, the listing generally reflects the sites with little development and relatively low installation costs based on current prices.

All other sites investigated but not proposed for early action or suggested as most likely long-range potentials are tabulated in Addendum G to Appendix M. Many of those have excellent capability for meeting unforeseen or future needs. Information regarding physical site capabilities, limitations, and preliminary costs is available in the Portland office of SCS.

Studies

SCS took the lead in studies of 126 watersheds in accordance with Department of Agriculture guidelines and the basic requirements of PL 83-566, as amended. Those studies, conducted in coordination with other

Task Force agencies and in cooperation with local soil and water conservation districts, resulted in the selection of 26 early-action, and the identification of 45 potential long-range, watershed projects. Those projects would be added to the six now existing or assured.

Those projects would include land treatment measures as well as structural measures. Principal purposes to be served would be flood protection, irrigation, drainage, and recreation. In addition, stored water and water area would be available for fish and wildlife, municipal and industrial water supply, and water quality control. Final decisions as to project purposes to be served, project sizes, financing of installations, and responsibilities for operation and maintenance are yet to be made. All such decisions will be made in agreement with local project sponsors.

Numbers of projects, by categories, and acreages served are summarized in Table C-1. Overall, those projects would include a total of 71 reservoirs, as shown on Map V-1 of Appendix M, with about 756,000 acre-feet of storage space; facilities for irrigation of about 150,000 acres of land; and about 588 miles of channel improvement for flood control and drainage. Water supply for irrigation would include natural flows, existing and authorized Federal storage, and storage as an element of the watershed projects. A small part of the watershed project storage would be alternative to irrigation use of existing and authorized Federal storage. Local decisions as to course of action to be followed will be required in those cases.

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Table C-1
Projects studied by Soil Conservation Service

Project Category	No. of Reservoirs	Capacity Ac.-ft.	Channel Impr. miles	Area to be Irrigated, Acres
Existing & Assured:				
Six watersheds	2	32,500	124	10,800
Early-Action:				
Twenty-six watersheds	39 1/	325,500	186	59,300 2/
Long-Range Potentials:				
Forty-five watersheds	30 3/	398,000	278	80,000
Total	71	756,000	588	150,100

1/ In 20 projects. Includes seven reservoirs which would provide an alternative to use of existing Federal storage, and two reservoirs which are alternatives to development either under PL 84-984 or as part of a potential early-action USBR multiple-purpose project.
2/ Includes about 8,000 acres which could be irrigated from existing Federal storage and about 5,200 acres which could be irrigated from new storage either under PL 84-984 or as part of a potential early-action irrigation division.
3/ Additional storage, partly in early-action watershed project areas.

The overall estimated cost of developments studied by SCS would be in the order of $134 million for structural measures, plus roughly $27.5 million for associated land treatment measures under ongoing programs. Annual operation and maintenance costs, all non-Federal, would total roughly $5 million. Structural measure costs, by project categories, would be as follows:

Project Category	Costs, $1,000,000 Construction	Annual O&M
Existing and Assured	18.1	0.4
Early-Action	49.2	2.0
Long-Range	66.5	2.6
Totals	133.8	5.0

Bureau of Reclamation

Procedures

In the Bureau of Reclamation (USBR), the process of project formulation consists of selecting the purposes to be served, the physical means

of development, and the size of the facilities and service area to be included in the plan. The objective is to promote efficient development and utilization of water and land resources and to encourage economic growth and stability as a means for improving the quality of living conditions. Project plans must fit within the framework of State and Federal law and policy, and engineering features must provide economic and social gains of public significance. Full consideration is given to the impact that the plan would have on the environmental aspects of the area.

The use of water resources is closely tied to the use of land resources and all practical uses of both land and water are given consideration in selecting project purposes. Engineering, economic, and social principles are applied to select the most efficient combination of alternative, competitive, and complementary uses, and to take advantage of the inherent economy and greater utilization of resources made possible by multiple-purpose development.

In selecting the way to serve project purposes, evaluations are made of the various means of developing the same site, the use of different sites to serve the same purposes, and combinations of several sites and types of facilities. Engineering economy is dependent upon the selection of the most desirable method, materials, and types of structures.

Construction of a project makes a partial or complete commitment of resources, especially where structures will last for many years. It is important, therefore, that facilities be designed to the proper size. If too small, optimum development may be precluded; if oversized, full use may be long deferred or never achieved. The primary method of determining the proper scale of development is referred to as "incremental analysis."

Incremental analysis begins with the selection of a justifiable nucleus or core for the project plan. The cost of this nucleus must be less than its benefits and less than the costs of alternatives which could serve the same purposes to the same degree. The analysis continues by adding major segments of size or purpose and evaluating the resulting increments of benefits and costs. Segments yielding less benefits than costs are omitted; those producing more benefits than

costs are included in the plan. By testing segments in descending order of their benefit-cost ratios, until the last increment adds benefits only equal to the cost of its inclusion, an economically desirable plan having the maximum excess of benefits over cost is approximated.

There are several items which receive special consideration during the formulation of the project plan. Differences in the time and certainty of occurrence for benefits and costs of alternative plans, and differences in alternatives not reflected in monetary estimates of their benefits and costs, require that the finally selected plan include elements based on sound judgment along with elements based upon mathematical computations. Where the project will cause damages to certain resources, the project plan includes reasonably justifiable remedies or replacements. Similarly, provision is made for necessary relocation or salvage of significant scientific, historic, or archeological remains affected by the project. Project plans also include minimum basic facilities for public health, safety, and access. Structures are designed to be esthetically pleasing, and in harmony with the landscape. It is imperative that all USBR projects contribute significantly toward the preservation and enhancement of the environment.

Studies

USBR took the lead in studies of certain works for the control, development, and use of water and related land resources. Areas and streams involved are those in the second phase, Tualatin Project, and in six potential divisions of a Willamette River Project, Oregon, as described in Part V of this appendix, in connection with early-action elements of the plan. Works involved include mutliple-purpose storage reservoirs, and facilities for the diversion (or pumping), conveyance, and distribution of an irrigation water supply. Some elements would depend solely on storage development or natural flows and/or stored water from existing and authorized Federal reservoirs, while others would use a combination of sources. Storage projects studied by USBR would be operated to store water for irrigation; to control floods; and to provide water and/or water-surface areas for fish and wildlife, recreation, municipal and industrial supply, and water quality control.

The projects involved are summarized in Table C-2. Overall, those projects would include a total of 12 multiple-purpose reservoirs, with about 902,000 acre-feet of total storage space, and facilities for irrigation of some 318,000 acres of land. Nearly 54,000 acres of land would be served from existing and authorized Federal storage. Information on specific projects is available in the Salem office of USBR.

Table C-2
Projects studied by Bureau of Reclamation

Project Category and Name	Storage Data: No. of Reserv.	Storage Data: Capacity, ac.-ft. Usable	Storage Data: Capacity, ac.-ft. Total	Area to be Irrigated, Acres
Authorized:				
Tualatin	1	53,000	59,200	17,000
Early-action:				
Tualatin, 2nd phase	2	102,000	115,000	30,000
Willamette	9 1/	641,000	728,000	221,400
Subtotals	11 1/	743,000	843,000	251,400
Long-Range:				
Willamette	-	-	-	-
Basin Totals	12 1/	796,000	902,200	318,200 2/

1/ *Includes one project which is alternative to development under either PL 84-984 or PL 83-566.*
2/ *Includes about 53,700 acres to be irrigated from existing and authorized Corps of Engineers reservoirs.*

The overall estimated cost of developments studied by USBR would be in the order of $516 million. The required annual expenditures for operation and maintenance would be roughly $3.8 million. Those costs, by project categories, would be as follows:

Project Category	Costs, $1,000,000: Construction	Costs, $1,000,000: Annual O&M
Authorized	21	0.2
Early-action	495	3.6
Totals	516	3.8

Corps of Engineers

Procedures

The Corps of Engineers had conducted many investigations of varying scope and intensity in Willamette Basin in past years. Those investigations led to development of the present Willamette Basin Project, which provides a base upon which to build for the future. Those investigations also provided a valuable catalog of information.

Review of that information indicated many areas of basic data deficiency. Among the activities of the Corps to offset those deficiencies were the financing of an expanded stream-gaging network and installation of a system of crest-stage gages to permit better hydrologic determinations.

For specific data leading to project evaluations and proposals, extensive and intensive field investigations and office studies were conducted. Those activities were coordinated with the other construction agencies in accordance with the adopted general formulation procedures.

Of the some 600 identified potential storage sites, the Corps investigated about 250. The sequence of investigations followed the general pattern of: map evaluation, field inspection, preliminary cost estimate, surface geological investigation, detailed mapping, subsurface geological and materials studies, real estate appraisal, and detailed cost estimate. Results of any one of those sequential steps could indicate that further investigations were unwarranted; correlation of data with other study participants permitted comparative evaluations of the respective sites.

Nonstorage project investigations followed appropriate similar steps.

As needs data were developed, a process of matching was undertaken to determine the degrees of service which could be provided by the various alternatives available. This demonstrated the physical capability for satisfaction of needs for the basin and its various subdivisions. The economic value, or benefits, of needs satisfaction is an important indicator of the urgency of such satisfaction. Accordingly, economic analyses were necessary to proceed with the selection of specific proposals and establish some priority of accomplishment. Since not all

planning is susceptible to strict economic analysis, however, some decisions were based on policy, judgment, or other considerations.

Proposals were developed on the basis of meeting needs through any and all available measures, and not just on economic evaluation of specific potential projects.

Studies

The Corps took the lead in studies of potential new multiple-purpose storage projects as possible additions, together with projects studied by SCS and USBR, to the existing and authorized storage system. It made studies of potential nonstorage projects for flood control and navigation. It cooperated with Bonneville Power Administration (BPA) and the Federal Power Commission (FPC) in studies of potential single- and multiple-purpose power development. Information on specific projects studied is available in the Portland District office.

Multiple-purpose storage studies included the possibility of new projects, by all agencies as noted above, as additions to the system of existing reservoirs, and the possibility of physical and/or operational modifications to existing and authorized Corps reservoirs when operated as elements of an expanded system. Project uses, or functions considered, included flood control, irrigation, navigation, power generation, water supply, water quality control, fish and wildlife, and recreation.

The potential new projects studied by the Corps would add about 1 million acre-feet of total storage space to the existing and authorized system of major storage projects. The resulting potential storage system (in addition to projects studied by USBR and SCS) would be about as follows:

Table C-3
Storage projects studied by Corps of Engineers

Project Category	Total Capacity, ac.-ft.	Costs, $1,000,000 Construction	Annual O&M
Existing:			
Eleven projects 1/	2,452,000	412.0	2.3
Authorized:			
Four projects	318,000	138.8	0.5
Early-action:			
Six projects 2/	506,000	122.1	1.1
Long-range:			
Eight projects	520,000	146.3	N/A
Totals	3,796,000	819.2	N/A

1/ Including associated reregulation facilities, where necessitated by peaking operation of power-generating installation.
2/ Including modification to an existing project and enlargement of an authorized project.

Single-purpose power projects, studied in cooperation with BPA and FPC, consist of seven long-range potentials. One of the long-range potentials would be for conventional single-purpose hydro development. The remainder would be pumped-storage projects for peaking capacity in the Pacific Northwest generating system. Table V-4 of this appendix summarizes those power-generating elements of the comprehensive plan. It also includes available information on two potential nuclear-fueled thermal plants under consideration by the private sector. Locations of the hydro projects are shown on Map V-1 of Appendix M.

Flood control projects studied include: (1) a basin system of channel improvement works associated with major reservoirs operated for flood control, channel stabilization on uncontrolled streams, and two separate channel improvement projects, all for early action; and (2) additional channel stabilization on uncontrolled streams, one separate channel improvement project, and additional basin-system channel improvement, all for long-range action.

The basin-system channel improvements are essential for proper flood control operation of major storage reservoirs. Separate channel stabilization, on uncontrolled streams, also is for flood control, including erosion control, sediment reduction, improved water quality, stabilized fish habitat, and related aspects. The three separate channel improvement projects, however, will be planned to include development of available recreation potential as well as preservation of environment. The additional basin-system channel improvements could include some levees and channel realignment. Table C-4 summarizes the nonstorage flood control elements of the comprehensive plan which were studied by the Corps.

Table C-4
Flood control projects studied by Corps of Engineers

Project Category and Type	Miles of Improvement	Costs, $1,000,000 Construction	Annual O&M
Existing:			
Channel stabilization	95	13.8	0.06
Continuing authorities 1/	-	5.7	N/A
Subtotals	95	19.5	N/A
Authorized:			
Channels 2/	470	N/A	N/A
Early-Action:			
System channels	47	11.2	0.09
Two trib. channels 3/	120	40.4	0.84
Channel stabilization 4/	5	0.9	0.01
Subtotals	172	52.5	0.94
Long-Range:			
One trib. channel 5/	55	12.3	N/A
Channel stabilization	5	1.1	N/A
System channels	55	13.3	N/A
Subtotals	115	26.7	N/A
Totals	852	98.7	N/A

1/ Small flood control projects, clearing and snagging, and emergency work.
2/ Reflects all outstanding authorizations; some of the projects involved have been deferred or declared inactive, and some may be constructed outside of current authorizations.
3/ Tualatin and Pudding Rivers, including recreation and environmental preservation.
4/ On uncontrolled streams.
5/ Yamhill River, for flood control and undefined recreation development.

The existing navigation project, consisting of a multiple-lift lock at Willamette Falls and a partially complete shallow-draft channel, would be modified. Modification would consist of: (1) constructing the presently authorized single-lift Willamette Falls navigation lock and (2) providing an increment of additional depth for the shallow-draft channel. Final decisions as to the increment of depth to be provided and the upstream limit of the modification will require additional study, including storage project sizing, storage system operation, and cost allocation. Based on present estimates of available benefits, an

investment in the order of $22 million could be justified for the total modified project, including the $13.6-million cost of a new lock.

Potential Private Sector Projects

As discussed in Part IV of this Appendix, the Task Force has no specific and detailed information as to plans for private-sector development. It is aware, however, that planning is underway for potential nuclear-fueled thermal generating installations, possibly in the basin. Also, it anticipates private-sector developments in the recreation field and in irrigation, but has little information as to specific items of development.

Nuclear-fueled Power Generation

At present, a number of sites in Willamette Valley and on the Oregon coast are being studied. Some of the sites are in Long Tom Subbasin and might be adaptable to use as an element of the solution to the recreation problem at Fern Ridge Reservoir. No firm cost estimate is available but it appears likely that the necessary investment in power generation at each 1,000-megawatt installation would be in the order of $200 million. Any added costs which might be incurred in connection with the Fern Ridge recreation problem are yet to be determined, but would not be chargeable to power. Plant demands for water for cooling purposes are not definitely known, but probably would be in the order of 30-40 cubic feet per second, consumptive, if pond cooling were used. Once-through cooling, using flows of about 1,600 cubic feet per second, is not possible under State standards for water quality.

Fanno Creek Recreational Lake

Washington County, Tualatin Hills Park and Recreation District, and the cities of Beaverton and Tigard have retained the services of a consulting firm to evaluate the possibility of a multiple-purpose lake. The project would be located in Subbasin 8, Tualatin, on Fanno Creek, a tributary to Tualatin River. The site is one which apparently does not have an adequate supply of natural runoff for maintenance of a dependable low-water season pool. The needed supplemental supply for maintenance of a 300-acre lake would consist of reclaimed, once-used domestic waste water. Such a supply apparently could be provided by any

necessary additional treatment of liquid municipal wastes treated in conformity with standards and regulations established by the State Department of Environmental Quality. The location being considered is in an area for which a vote of the residents has established a district, under State law, for the collection and treatment of municipal and industrial waste waters according to a Washington County Master Plan for Sewerage Facilities.

The plan under consideration would include the lake and about 800 acres of associated park land with major recreation facilities capable of providing for about 1.25 million recreation-days of use annually. Other potential benefits would include provision of about 2,700 acre-feet of storage space, which might be usable for flood control, and possible ground water recharge capability. Also, the additional treatment and lake, in combination, would solve any problems of disposal of plant effluent and provide a source of irrigation water for the associated park and recreation areas. It is not yet known whether such a facility would be compatible with the Master Plan.

Preliminary data indicate costs for the proposed treatment-recreation facility would be in the order of $20 million.

Other Development

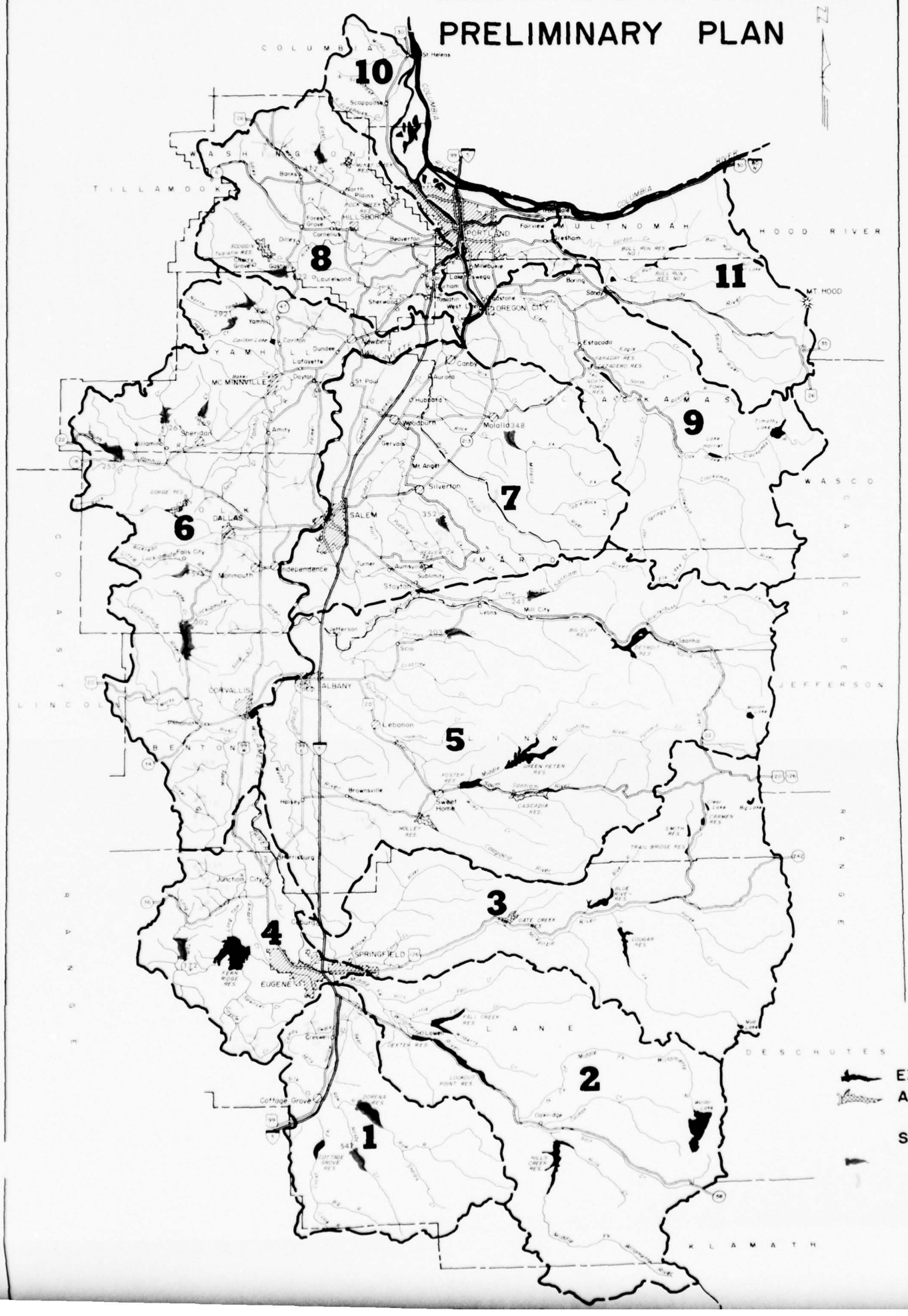
The private sector is anticipated to participate in additional recreation and irrigation development, both separately and in connection with recreation and irrigation programs as subsequently discussed under the heading Early-Action Elements in Part V of Appendix M. Also, it may participate in the development of ground water sources to supply municipal and industrial as well as irrigation needs. Information is not available as to specific locations, extent and nature, or cost of potential private-sector development. Such information, and appropriate coordintion with agency plans and capabilities, would be developed for recreation by or through the agency-public coordinating committee discussed in text on recreation programs. Consistent with present recreation needs and conditions, emphasis probably will be on areas west of Willamette River.

In addition to recreation development, there is a considerable opportunity for private-sector development of additional single-purpose

power projects. Included in that category are the conventional generating site and the potentials for pumped-storage peaking development, both as listed in Table V-4 of Appendix M. As stated in Appendix J, Power, additional studies will be required to determine how pumped-storage development could best fit into the region's load pattern. The development of nuclear-fueled thermal installations as discussed above, however, would provide at least a part of the dependable off-peak generating capacity needed to support pumped-storage installations.

WILLAMETTE BASIN STUDY

PRELIMINARY PLAN



LEGEND

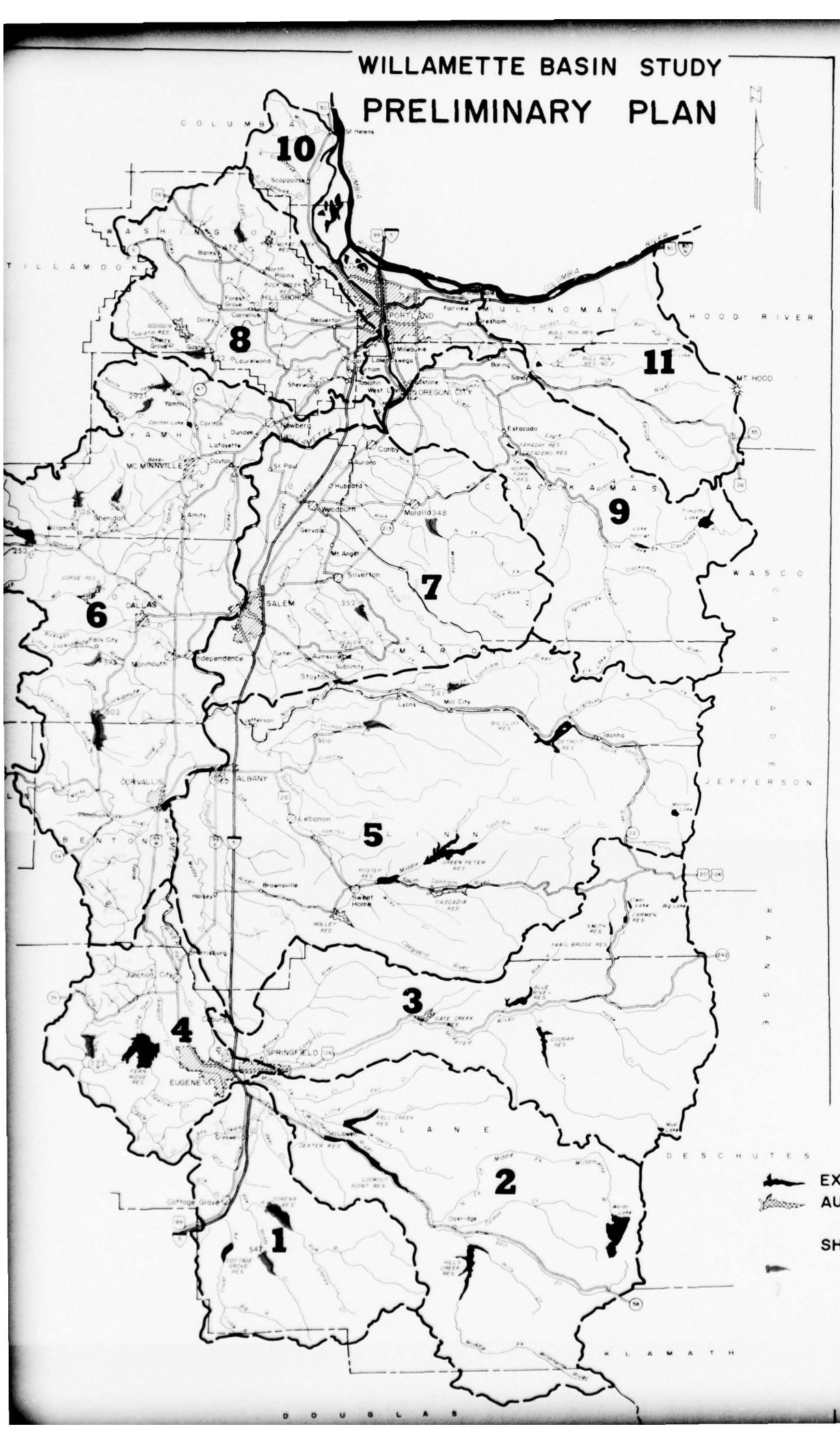
EXISTING PROJECTS

AUTHORIZED PROJECTS

SHORT RANGE
25,000 AC.
UNDER 25,

WILLAMETTE BASIN STUDY

PRELIMINARY PLAN



LEGEND

- EXISTING PROJECTS
- AUTHORIZED OR ASSURED PROJECTS
- SHORT RANGE PROJECTS
  - 25,000 AC. FT. & OVER
  - UNDER 25,000 AC. FT.

PRELIMINARY PLAN
POTENTIAL NEW STORAGE PROJECTS

Site	No.	Stream	Storage Considered (acre-feet)	Probable Functions [1]
Dorena [2]		Row R.	10,000	FC, R, F&WL, N
Abrams	547	Mosby Cr.	45,000-90,000	FC, R, F&WL, N
	17	N. Fk. Camas Swale Cr.	6,400	I, WS
	25	Trib. Coast Fk.	9,000	WS
	26	Camas Swale Cr.	20,000	FC, R
Upper Noti	172	Long Tom R.	30,000-60,000	FC, R, F&WL, N
Ferguson Cr.	134	Ferguson Cr.	8,770	R
	167	Trib. Ferguson Cr.	5,700	FC, I
Bear Cr.	129	Bear Cr.	2,500	FC, I
	573	Owens Cr.	8,200	FC, I, R
Gillespie Corner	137	Fox Hollow	10,500	I, WS, F&WL
Bunker Hill	130	Coyote Cr.	10,000	R
Jordan	203	Thomas Cr.	70,000-140,000	FC, I, R,WS,F&WL,N
Lyons	241	L. No. Santiam R.	102,000-204,000	FC, I, R,WS,F&WL,N
Sucker Slough	237	Sucker Slough	7,200	FC, R
Courtney Cr.	191	Courtney Cr.	6,350	R
	243	L. Muddy Cr.	3,390	R
Pedee	302	Luckiamute R.	93,500-187,000	FC, I, R,WS,F&WL,N
Black Rock	574	L. Luckiamute R.	17,000	FC
Teal Cr.	575	Teal Cr.	25,000	I, R, WS
Staats Cr.	316	Staats Cr.	3,600	I
Sulphur Spr.	317	Soap Cr.	13,000	FC, I, R
Beaver Cr.	259	Beaver Cr.	13,000	I
Oliver Cr.	299	Oliver Cr.	9,600	FC, R
Reese Cr.	310	Reese Cr.	9,600	I
Agency	253	S. Yamhill R.	64,500-76,000	FC, I, R, F&WL
Buck Hollow	261	Willamina Cr.	64,000-76,000	FC, I, R, F&WL
Gopher Valley	269	Deer Cr.	45,000	FC, I, R, F&WL
	576	Salt Cr.	3,600	R
	579	Salt Cr.	8,400	I
	577	W. Fk. Salt Cr.	9,500	I, WS
Palmer Cr.	300	Palmer Cr.	7,800	I, R
Moores Valley	292	Haskins Cr.	30,000	I, R, F&WL
Pike	306	N. Yamhill R.	63,000-80,000	FC, I, R, WS, F&WL
Spring Valley Cr.	315	Spring Valley Cr.	4,800	I
N. Fk. Ash Cr.	296	N. Fk. Ash Cr.	3,100	FC, WS, F&WL
M. Fk. Ash Cr.	291	M. Fk. Ash Cr.	3,000	FC, R
	578	Trib. Chehalem Cr.	2,400	FC, I, WS, F&WL
	581	Trib. Chehalem Cr.	2,300	FC, I, F&WL
	580	Spring Br.	2,640	R
Dickey Bridge	348	Molalla R.	306,000	FC, I, R, WS, F&WL
Grange	352	Silver Cr.	80,000	FC, I, R, WS, F&WL
Selah	386	Pudding R.	22,000	FC, I, R, F&WL
	410	Drift Cr.	9,000	I, WS
Ebner	350	Pudding R.	5,200	R
Coal Cr.	586	Coal Cr.	15,600	I, WS
Jefferson Rd.	358	Battle Cr.	2,700	WS
Miller	367	Mill Cr.	5,950	FC, WS
	588	Beaver Cr.	21,200	FC, R
E. Fk. Dairy Cr.	417	E. Fk. Dairy Cr.	53,000	FC, I, R, F&WL
Gaston	422	Tualatin R.	60,000	FC, I, R, WS, F&WL
	449	Trib. W. Fk. Dairy Cr.	8,900	I
Tolke Canyon	435	Witcher Cr.	6,100	R
	438	Bledsoe Cr.	8,000	R
	440	E. Fk. Dairy Cr.	22,100	I, WS, F&WL
	515	Trib. Johnson Cr.	3,260	FC, R
	591	Trib. Johnson Cr.	3,500	FC, R
	592	Trib. Johnson Cr.	3,600	FC, F&WL
	566	Fairview Lake	1,740	R



[1] FC = Flood Control
I = Irrigation
R = Recreation
WS = Water Supply
F&WL = Fish and Wildlife
N = Navigation

[2] Existing project proposed for enlargement for the purposes shown.

This handout describes a preliminary plan involving the projects now existing, under construction, authorized, and assured, also referred to as the base system, and potential new projects and programs. That plan, as much as possible at this time, is responsive to testimony on needs and solutions thereto submitted by many of the residents of Willamette Basin at public hearings during the early stages of this comprehensive study. It further is responsive, again to the extent possible, to data submitted by local water resource committees, by private and public agencies, and by interested individuals subsequent to the public hearings.

The next step in plan formulation and evaluation will be to hold agency meetings, at local request, to discuss individual projects. Through such agency meetings, residents of Willamette Basin will have the opportunity to obtain more detailed information and to further comment on the plan and individual elements thereof. *Requests for agency meetings can be submitted directly to the agency concerned, or if you are not sure of which agency, to Mr. Walter D. Jaspers, Executive Secretary to the Task Force, Room 394, Federal Building, Broadway & Gliesan N. W., Portland, Oregon 97208, phone 226-3361 ext. 1506; or to Mr. A. Warren Jones, Executive Secretary to the Willamette Basin Project Committee at 2-M, Marion County Courthouse, Salem, phone 364-1664.*

Before the study is completed, considerable further study, including economic analysis and cost allocations, will be made, and a final plan will be presented in detail at final public hearings.

Upon completion of the study in June 1969, a report will be submitted to the Pacific Northwest River Basins Commission and to field representatives of participating State and Federal agencies for review and comments.

Upon completion of that review, the report will be forwarded to the Water Resources Council in Washington, D. C., and will be available to agencies and State and local entities. It will be used by agencies as a supporting document for agency authorization reports processed through normal agency channels.

Preliminary Plan
Water and Related Land Resource Development
Willamette Basin
August 22, 1968

The Willamette Comprehensive Study, an inter-agency investigation of water resource development needs of the basin, is nearing completion. The 35 cooperating State and Federal agencies, under the direction and coordination of the Willamette Basin Task Force, have been charged with preparing a plan for water and related resource projects and programs to meet future needs.

The potential new projects and programs listed in this handout do not constitute the final basin plan. Rather, they represent a preliminary estimate of the elements which may survive further study, including tests of economic feasibility and local support. This preliminary information is being made available to interested persons so as to permit their views to be made known and considered, and thus insure that the final plan will reflect the desires of the basin residents to the maximum practicable extent. This consideration, alone, may dictate additions to or deletions from the project and program listing shown herein.

The preliminary plan elements listed below are termed short-range in that it appears they will require action in the next 10-15 years to meet projected needs.

The final plan to be recommended will include the existing system of projects, the potential new short-range elements, and also potential long-range projects and programs to meet needs to the year 2020. Some of the projects listed in this handout as potential short-range projects may, upon further study, be shifted to the long-range category.

Major new elements of the preliminary plan include:

Enlargement of Dorena Reservoir and construction of 58 new reservoirs to provide additional storage of 1.5 to 1.9 million acre-feet. Fifteen of these projects would range from 25,000 to over 300,000 acre-feet capacity; the others would be less than 25,000 acre-feet (See map).

Since not all water resource development needs which will exist by 1980 can be met by storage of water, additional short-range elements of the preliminary plan include:

An 8-foot deep navigation channel upstream to Albany, including reconstruction of Willamette Falls Locks.

Irrigation facilities for application of water to 186,000 additional acres to provide food and fiber for an increased population, both in and outside of the basin.

Fish-passage facilities at 30 barriers in the stream system above Willamette Falls.

Hatchery facilities to produce sufficient fish to insure an escapement of 80,000 anadromous fish and provide a resource to support about 360,000 angler-days of resident trout fishing annually.

Channels and related works including: 50 miles of bank protection at about 150 locations along Willamette River and its major tributaries; flood evacuation channel closures totalling about 2-1/2 miles; about 100 miles of primary channel improvement; and, improvement of 200 miles of channels on minor tributaries for flood protection and drainage.

Accelerated land treatment programs including: 27 small watershed projects; 250 miles of gully stabilization; 390 miles of channel revetment and debris removal in mountain streams; 147,000 acres of critical erosion area treatment; and 500 miles of road and trail restoration on forest lands.

Recommendations for possible reallocation or addition of functions to the existing Federal reservoir system.

Recommendation for capital expenditures to meet unsatisfied recreation needs which are expected to reach 14 million recreation days annually; for acquisition of refuges and game management areas; for acquisition of access rights to hunt big game, upland game, small game, and waterfowl; for development of roads and other access facilities at a rate consistent with increasing hunting and fishing demand; and for vegetation management in the interests of stream stabilization and enhancement of wildlife habitat.

The preliminary plan also provides for recommendations with respect to legislative action and basic data collection programs.

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ADDENDUM E

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
PACIFIC NORTHWEST REGION
U. S. COURT HOUSE
SEATTLE, WASHINGTON 98104

IN REPLY REFER TO:
D6427

1969

Memorandum

To: Interior Representative, Willamette Basin Task Force

From: Chairman, Recreation Committee, Willamette Basin Comprehensive Study

Subject: Recommendation for preservation of free flowing streams

Reference is made to our letter of October 9, 1969, to committee members requesting their comments on the proposed list of streams to be managed as free flowing. We have received and evaluated committee comments and herewith include a revised list of streams to be managed under the concept explained below.

Management for Preservation - Protection

The Recreation Committee feels that certain streams have such a high recreational and environmental value, because of location and natural characteristics, that they should be placed immediately under a preservation and protection management which would retain their natural condition. This type of management would require, for the streams named, extensive justification and display of an overriding need before any proposed development which would alter the resource could be approved. This management level would fall between present land management practices which apply to most public lands, and the legislated protection and preservation of dedicated areas. The streams recommended for inclusion are:

Entire Willamette River
- Coast Fork River
  - Mosby Creek
- Middle Fork River
  - North Fork River

Tualatin River
Yamhill River
Rickreall Creek
Mary's River
Sandy River
Clackamas River
- Eagle Creek
- Collowash River

Molalla River
Butte Creek (Pudding drainage)
Abiqua Creek (Pudding drainage)

The $7 Annual Golden Eagle Passport admits carload of people year-long to all designated Federal recreation areas

Santiam River
- North Santiam River
  - Little North Santiam River
  - Breitenbush River
- South Santiam River
  - McDowell Creek
  - Wiley Creek
- Middle Santiam River

Calapooia River

McKenzie River
- White Branch Creek
- Horse Creek
- French Pete Creek
- South Fork McKenzie River

All streams within the boundaries of the Mt. Hood, Mt. Jefferson, Mt. Washington, Three Sisters, and Diamond Peak Wildernesses.

All streams within the boundaries of the Columbia Gorge, Mt. Hood, and Waldo Lake Recreation Areas.

This recommendation does not apply to segments of named streams containing existing or authorized projects.

The proposed management objectives for these streams are as follows:

1. Maintain and enhance the beauty and other aesthetic qualities of the environment.

2. Maintain the available options for future change, either for possible development or permanent preservation.

3. Enhance the opportunities for outdoor recreation consistent with minimum modification of the landscape to maintain a natural scenic appearance.

4. Retain, if available, optimum streamflows for recreation, environmental, and fishery purposes. If flows are not available, water storage projects on tributary streams should be considered to supplement existing flows.

It must be emphasized that the management proposed for the streams listed does not amount to a downgrading of the status of other streams. Justification should be shown for altering the nature of any stream within the basin.

The selection of the streams listed was not based on a weighted set of criteria or any other stated methodology; but rather, the list was compiled from committee members' suggestions based on individual knowledge of location, stream values, and needs. Outstanding scenic, fish, wildlife, geological, archeological, historical, and outdoor recreation values of present and future benefit to the public were considered. In addition, locational needs for preservation of stream

values were recognized. The listed streams provide a good distribution of high quality, free flowing streams within the basin which is much preferred to a concentration of streams in a single area.

The Coast Fork, Middle Fork, McKenzie, Long Tom, and Santiam subbasins contain a surplus of slack water for outdoor recreation until at least the year 2000. Therefore, it can be generally assumed that the streams in these subbasins would better satisfy recreation needs by remaining in a free flowing state.

The three listed streams within the Coast Range Subbasin are ideally located with regard to population and generally contain higher stream values than other Coast Range streams.

The streams selected in the Pudding Subbasin and the lower subarea also provide a good distribution of streamside values with respect to population, and these streams represent a good cross section of scenic, environmental, and recreational values and opportunities.

Would you please forward a copy of this memorandum to Henry Stewart for use in plan formulation.

Mark J. Pike
Chairman, Recreation Committee

A D D E N D U M F

MINIMUM STREAMFLOWS ESTABLISHED BY OREGON STATE WATER RESOURCES BOARD

Oregon State Water Resources Board, in establishing programs for the unappropriated waters of the State, has established minimum streamflows for streams in the Willamette Basin study area. Those flows are summarized as follows:

Subarea, Subbasin, and Stream	Flows, Cfs 1/	Location
Willamette River	1,750/3,140	Gage 1740
Willamette River	1,300/4,700	Gage 1910
Willamette River	1,500/4,700	Gage 1980
Upper Subarea:		
Subbasin 1, Coast Fork:		
Coast Fk. Will. R.	15/100	Row R. confluence
Row River	40/150	Mouth
Coast Fk. Will. R.	40/250	Mouth
Subbasin 2, Middle Fork:		
Middle Fk. Will. R.	285/690	N. Fk. confluence
N. Fk. of Middle Fk.	115/0	Mouth
Fall Creek	40/470	Mouth
Middle Fk. Will. R.	640/1,475	Mouth
Subbasin 3, McKenzie:		
S. Fk. McKenzie R.	200/230	Mouth
Blue River	30/350	Mouth
McKenzie R.	1,400/580	Gage 1625
Gate Creek	20/0	Mouth
Mohawk River	20/0	Mouth
McKenzie River	1,025/700	U.S. Hwy. I-5
Subbasin 4, Long Tom:		
Long Tom River	0/370	Gage 1700
Middle Subarea:		
Subbasin 5, Santiam:		
Calapooia River	30/340	Gage 1720
Calapooia River	20/340	Gage 1735
S. Santiam River	50/0	Gage 1850
Middle Santiam River	110/260	Gage 1865
Wiley Creek	10/0	Mouth
S. Santiam R.	170/930	Gage 1875
N. Santiam R.	345/0	Gage 1780
N. Santiam R.	500/640	Gage 1815
L. N. Santiam R.	40/0	Gage 1825
N. Santiam R.	580/640	Gage 1830
N. Santiam R.	430/640	Gage 1841
Santiam R.	330/1,570	Gage 1890
Santiam R.	320/1,570	Mouth

Subarea, Subbasin, and Stream	Flows, Cfs, 1/	Location
Middle Subarea (Cont'd):		
Subbasin 6, Coast Range:		
Marys River	10/0	Gage 1710
Marys River	5/0	Mouth
Luckiamute River	10/0	Gage 1895
Luckiamute River	20/0	Gage 1900
Luckiamute River	25/0	Gage 1905
Luckiamute River	20/0	Mouth
Rickreall Creek	5/0	Gage 1907
South Yamhill River	20/0	Gage 1925
Willamina Creek	20/0	Gage 1930
South Yamhill River	15/0	Gage 1940
North Yamhill River	10/0	Gage 1970
Yamhill River	15/0	Gage 1975
Subbasin 7, Pudding:		
Pudding River	10/0	Gage 2010
Pudding River	35/0	Gage 2020
Molalla River	35/0	Gage 1985
Molalla River	60/0	Gage 2000
Lower Subarea:		
Subbasin 8, Tualatin:		
Tualatin River	15-30/0	Gage 2075
Tualatin River	0-15/0	Gage 2035
Tualatin River	10-65/0	Mile 70
McFee Creek	2-12/0	Ab. Gulf Can. Cr.
E. Fk. Dairy Creek	12-50/0	Mile 13
Plenty Water Creek	1-5/0	Mouth
Denny Creek	2-15/0	Mouth
McKay Creek	4-36/0	Mile 15.5
E. Fk. McKay Creek	0-2/0	Mouth
Gales Creek	12-100/0	Mouth
Gales Creek	8-70/0	Mile 12
L. Beaver Creek	0-1/0	Mouth
Beaver Creek	1-17/0	Mouth
S. Fk. Gales Creek	1-20/0	Mouth
N. Fk. Gales Creek	1.5-25/0	Mouth
Seine Creek	2-25/0	Mouth
Tanner Creek	1-9/0	Mouth
Subbasin 9, Clackamas:		
Clackams River	400-640/0	Gage 2095
Clackamas River	150-240/0	Gage 2080
Clear Creek	0-40/0	Mouth
Clear Creek	0-25/0	Above Viola
Deep Creek	10-35/0	Mouth
N. Fk. Deep Creek	1-20/0	Mouth
Tickle Creek	4-30/0	Mouth
Eagle Creek	40-125/0	Mouth
N. Fk. Eagle Creek	10-45/0	Mouth
Fish Creek	15-60/0	Mouth
Fish Creek	0-3/0	Ab. Wash. Cr.

Subarea, Subbasin, and Stream	Flows, Cfs 1/	Location
Subbasin 9 (Cont'd):		
Wash. Creek	3-25/0	Mouth
Roaring River	40-100/0	Mouth
Oakgrove Fk.	0-10/0	Mouth
Collawash River	75-250/0	Mouth
Hotsprings Fk. Collowash R.	15-75/0	Mouth
E. Fk. Collawash R.	0-10/0	Mouth
Elk Lake Creek	0-15/0	Mouth
Pinhead Creek	50-75/0	Mouth
Lowe Creek	2-8/0	Mouth
Subbasin 10, Columbia:		
So. Scappoose Creek	5-25/0	Above Raymond Cr.
Raymond Creek	0.5-8/0	Mouth
Gourlay Creek	0.5-10/0	Mouth
N. Scappoose Creek	5-40/0	Mouth
Deep Creek	0.5-7/0	Mouth
Alder Creek	1-8/0	Mouth
Cedar Creek	1-6/0	Mouth
Lizzie Creek	1-6/0	Mouth
S. Fk. of N. Scappoose Cr.	1-8/0	Mouth
N. Fk. of N. Scappoose Cr.	1-7/0	Mouth
Milton Creek	0-25/0	Ab. Salmon Cr.
Cox Creek	0-6/0	Mouth
Salmon Creek	0-5/0	Mouth

1/ Numbers shown, as 15/100, are natural flows(15) and storage releases (100). Where range of values is shown, stipulated minimum flows vary seasonally.

ADDENDUM G

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 1. Coast Fork

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
6	COAST FORK	Cottage Grove No. 3	20	22S	3 W	86,000	
7	COAST FORK	Cottage Grove No. 4	21	21S	3 W		Limited storage
5	COAST FORK	Cottage Grove No. 2	16	21S	3 W		Limited storage
4	COAST FORK	Cottage Grove No. 1	9	21S	3 W		Limited storage
8	COAST FORK	Creswell No. 1	30	18S	2 W		Development in reservoir
9	COAST FORK	Creswell No. 3	19	18S	2 W		Development in reservoir
22	Big R.	-	4	23S	3 W	25,000	
14	Martin Cr.	-	24	21S	4 W	1,500	Alternate to site 12
13	Martin Cr.	-	24	21S	4 W	3,100	Alternate to site 12
12	Martin Cr.	-	24	21S	4 W	3,200	
20	Silk Cr.	-	24	20S	4 W	5,700	
23	Silk Cr.	-	30	20S	3 W	7,900	
21	Unnamed Trib.	-	23	20S	4 W	1,500	
10	Row R.	Disston	35	21S	1 W	90,000	
19	Row R.	Rocky Point	19	21S	1 W		Development in reservoir
15	Row R.	Mosby Cr.	35	20S	3 W		Development in reservoir
3	Brice Cr.	Champion Cr.	23	22S	1 E		Poor storage
28	Sharps Cr.	Walker Cr.	1	23S	1 W		Poor storage
16	Mosby Cr.	-	9	22S	2 W	25,000	Poor storage
547	Mosby Cr.	Abrams	5	22S	2 W	50,000	
11	Lynx Hollow	-	31	19S	3 W	2,140	
27	Bear Cr.	-	20	19S	2 W	4,700	
579	Camas Swale Cr.	-	26	19S	4 W	510	
594	Camas Swale Cr.	-	26	19S	4 W	280	
2	Camas Swale Cr.	-	26	19S	4 W	820	
1	Camas Swale Cr.		14	19S	4 W	5,300	
26	Camas Swale Cr.	-	8	19S	3 W	16,000	
595	Unnamed Trib	-	15	19S	4 W	290	
596	Unnamed Trib.	-	11	19S	4 W	520	
18	North Fork	-	32	18S	3 W	2,650	
17	North Fork	-	5	19S	3 W	6,400	
24	Unnamed Trib.	-	11	19S	2 W	1,250	
25	Unnamed Trib.	-	32	18S	2 W	10,000	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 2. Middle Fork

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
54	MIDDLE FORK	Swift Cr.	20	24S	5 E		Poor storage
53	MIDDLE FORK	Staley Cr.	11	24S	4 E		Excessive dam length
32	MIDDLE FORK	Campers Flat	12	24S	3 E	180,000	
31	MIDDLE FORK	Boulder Cr.	3	24S	3 E		Excessive dam length
570	MIDDLE FORK	Mile 50	34	22S	3 E	260,000	
52	MIDDLE FORK	Sand Prairie	9	23S	3 E		Poor left abutment
28	MIDDLE FORK	Lookout Point	25	20S	2 E		Development in reservoir
29	MIDDLE FORK	Black Canyon	21	20S	2 E		
42	MIDDLE FORK	Natron No. 1	9	18S	2 W		Development in reservoir
43	MIDDLE FORK	Natron No. 2	9	18S	2 W		Development in reservoir
44	MIDDLE FORK	Natron No. 3	8	18S	2 W		Development in reservoir
35	Hills Cr.	Kitson Hot Springs	5	22S	4 E		Poor storage
50	Salmon Cr.	-	32	20S	5 E		Limited yield
46	Salmon Cr.	North Fork No. 1	31	20S	5 E		Excessive dam length
33	Salmon Cr.	Eagle Butte	33	20S	4 E		Right abutment overburden
51	Salmon Cr.	Salt-Salmon	12	21S	3 E		Poor abutments
30	Black Cr.	-	22	21S	5 E		Limited yield
57	North Fork	Waldo Lake	7	21S	6 E		Limited yield
41	North Fork	Moolack Mountain	36	19S	5 E	110,000	
55	North Fork	Upper North Fork	27	19S	4 E	50,000	
47	North Fork	North Fork No. 2	36	19S	3 E		Poor storage
45	North Fork	Ninth Cr.	12	20S	3 E		Poor storage
34	North Fork	Huckleberry Cr.	24	20S	3 E		Poor storage
40	North Fork	Mile 7.5	26	20S	3 E		Poor storage
39	North Fork	Mile 6.7	27	20S	3 E		Poor storage
56	North Fork	Westfir	7	21S	3 E		Excessive overburden
49	Fall Cr.	Reserve	31	18S	2 E		
48	Fall Cr.	Pengra	31	18S	1 W		Development in reservoir
37	Little Fall Cr.	-	12	18S	1 E	20,400	
36	Little Fall Cr.	-	16	18S	1 E		
597	Rattlesnake Cr.	-	13	19S	2 W		
572	Rattlesnake Cr.	-	13	19S	2 W	2,400	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 3. McKENZIE

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
119	McKENZIE RIVER	Upper Falls	8	14S	7 E		Diversion
92	McKENZIE RIVER	Middle Falls	17	14S	7 E		Diversion
85	McKENZIE RIVER	Lower Falls	30	14S	7 E		Diversion
61	McKENZIE RIVER	Belknap	26	15S	6 E		Diversion
115	McKENZIE RIVER	Twisty Cr.	35	15S	6 E		Limited storage
74	McKENZIE RIVER	Frissel Cr.	2	16S	6 E		Poor abutments
107	McKENZIE RIVER	Scott Cr. Dam	11	16S	6 E		Excessive dam length
71	McKENZIE RIVER	Foley Ridge	9	16S	6 E	160,000	
101	McKENZIE RIVER	McKenzie Bridge	18	16S	6 E		Development in reservoir
90	McKENZIE RIVER	Paradise	18	16S	6 E		Excessive overburden
89	McKENZIE RIVER	McKenzie Bridge	13	16S	5 E		Diversion
63	McKENZIE RIVER	Combination	19	16S	5 E		Excessive dam length
110	McKENZIE RIVER	South Fork	28	16S	4 E		Development in reservoir
122	McKENZIE RIVER	Upper Quartz Creek	31	16S	4 E		Development in reservoir
102	McKENZIE RIVER	Quartz Creek	1	17S	3 E		Development in reservoir
99	McKENZIE RIVER	Nimrod	9	17S	3 E		Development in reservoir
105	McKENZIE RIVER	Rennie	5	17S	3 E		Development in reservoir
68	McKENZIE RIVER	Eugene Municipal Power Site No. 3	32	16S	3 E		
111	McKENZIE RIVER	Spaulding	31	16S	3 E		Development in reservoir
60	McKENZIE RIVER	Bear Cr.	31	16S	3 E		
98	McKENZIE RIVER	Nichols	36	16S	2 E		
87	McKENZIE RIVER	Martin Rapids	36	16S	2 E		
76	McKENZIE RIVER	Gate Creek	34	16S	2 E		Development in reservoir
123	McKENZIE RIVER	Vida No. 1	28	16S	2 E		Development in reservoir
124	McKENZIE RIVER	Vida No. 2	29	16S	2 E		Development in reservoir
125	McKENZIE RIVER	Vida No. 3	29	16S	2 E		Development in reservoir
66	McKENZIE RIVER	Deerhorn	17	17S	1 E		Development in reservoir
114	McKENZIE RIVER	Thurston	26	17S	2 W	500,000	Development in reservoir
79	McKENZIE RIVER	Hayden Bridge	30	17S	1 W		Development in reservoir
78	McKENZIE RIVER	Hayden Bridge	26	17S	2 W		Diversion
62	McKENZIE RIVER	Coburg	19	17S	2 W		Diversion
65	McKENZIE RIVER	Deadmond Ferry	15	17S	3 W		Development in reservoir
70	Fish Lake Cr.	-	32	13S	7 E		Limited yield
100	Olallie Cr.	-	18	15S	7 E		
84	Lost Cr.	-	14	16S	6 E		Excessive overburden
69	Horse Cr.	-	28	17S	6½E		Excessive dam length
72	Horse Cr.	Foley Springs	36	16S	6 E		Diversion
81	Horse Cr.	-	35	16S	6 E	75,000	
80	Horse Cr.	-	21	16S	6 E		Diversion
82	Horse Cr.	-	24	16S	5 E		Poor abutments

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 3. McKenzie

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	McKENZIE R. (cont.)						
	Horse Creek						
113	Separation Cr.	Three Sisters	16	17S	7 E		
77	Separation Cr.	Harvey Cr.	14	17S	6½E		
103	Separation Cr.	Rainbow Cr.	5	17S	6½E		Wilderness area
91	Mesa Cr.	-	16	17S	7 E		
83	South Fork	Lakes Diversion	35	18S	6½E		
67	South Fork	Elk Cr.	35	18S	6 E		Extension dam length
58	South Fork	Augusta Cr.	33	18S	6 E		Poor abutments
59	South Fork	Augusta Cr.	23	18S	5 E		Poor abutments
104	South Fork	Rebel Cr.	11	18S	5 E		
73	South Fork	French Pete Cr.	33	17S	5 E		
106	Roaring R.	-	1	19S	6 E		
64	Blue R.	Cook Cr.	30	15S	5 E		Poor storage
109	Solomon Cr.	-	5	17S	1 W	2,700	
118	Solomon Cr.	-	5	17S	1 W	4,000	
121	Mohawk R.	Upper Mohawk No. 2	28	15S	1 E	24,500	
120	Mohawk R.	Upper Mohawk No. 1	21	15S	1 E		
96	Mohawk R.	Mohawk No. 1	23	15S	1 W	11,700	Excessive overburden
95	Mohawk R.	-	17	17S	2 W	150,000	
97	North Fork	Mohawk Headquarters	31	15S	2 E	4,300	
108	Shotgun Cr.	-	19	15S	1 W	1,100	
116	Shotgun Cr.	-	30	15S	1 W	12,700	
94	Mill Cr.	Mill Creek No. 2	10	16S	1 E	8,370	
93	Mill Cr.	Mill Creek No. 1	10	16S	1 E	250	Diversion
126	Mill Cr.	Wendling	11	16S	1 W	13,000	
117	Cartwright Cr.	-	20	16S	1 W	820	
86	Cartwright Cr.	Marcola Tributary	20	16S	1 W	10,600	
88	McGowan Cr.	-	28	16S	2 W	3,200	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 4. Long Tom

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
163	WILLAMETTE RIVER	Springfield	2	18S	3 W		Development in reservoir
150	LONG TOM RIVER	-	8	16S	6 W	5,000	
175	LONG TOM RIVER	West Fork	28	16S	6 W		
161	LONG TOM RIVER	Smith	6	17S	6 W	11,000	
173	LONG TOM RIVER	-	17	17S	6 W		
172	LONG TOM RIVER	Upper Noti	21	17S	6 W	35,000	
171	LONG TOM RIVER	Noti	29	17S	6 W		
169	Unnamed Trib.	-	7	16S	6 W		
139	Jones Cr.	Hall Road	21	16S	6 W		
164	Swamp Cr.	-	36	16S	6 W	1,000	
165	Sweet Cr.	-	3	17S	6 W	1,700	
170	Hendricks Br.	-	4	17S	6 W	760	
133	Noti Cr.	Eudora Stevens	10	18S	6 W	8,000	
144	Hardy Cr.	-	8	18S	6 W	3,300	
157	Poodle Cr.	-	11	17S	7 W	14,300	
153	Poodle Cr.	Montgomery	13	17S	7 W	17,600	
149	Elk Cr.	Log Pond	30	17S	6 W	20,000	
145	Indian Cr.	-	22	17S	6 W	1,050	
141	Hannavan Cr.	-	11	17S	6 W	2,100	
168	Parker Cr.	-	14	17S	6 W	840	
140	Coyote Cr.	Hamilton Road	30	19S	4 W	4,000	
136	Coyote Cr.	Fox Hollow	25	19S	5 W		
130	Coyote Cr.	Bunker Hill	24	19S	5 W	10,000	
160	Coyote Cr.	Simonson Road	14	19S	5 W	2,200	Poor foundation
131	Coyote Cr.	-	32	18S	5 W		
548	Coyote Cr.	-	29	18S	5 W		
148	Fox Hollow	LeBleu School	8	19S	4 W	6,500	
152	Fox Hollow	McNutts	12	19S	5 W	9,100	
137	Fox Hollow	-	13	19S	5 W	10,500	
138	Nighswander Cr.	Hadleyville	3	19S	5 W	2,800	
155	Jordan Cr.	Nighswander	9	19S	5 W	2,500	
159	Unnamed Trib.	South Doan Road	34	18S	5 W	600	
127	Battle Cr.	-	31	18S	5 W	2,800	
154	Unnamed Trib.	North Doan Road	22	18S	5 W		
135	Unnamed Trib.	Ford Farm	22	18S	5 W		
162	Spencer Cr.	-	22	18S	4 W	7,700	
151	Spencer Cr.	McBeth	22	18S	4 W	830	
158	Spencer Cr.	Potters Corner	21	18S	4 W	12,600	
166	Spencer Cr.	Teng's	20	18S	4 W	14,400	
143	Spencer Cr.	Hanson's	24	18S	5 W	25,000	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 4. Long Tom

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	LONG TOM R. (cont.)						
	Coyote Cr.						
142	Spencer Cr.	Hanson's	24	18S	5 W	22,000	
128	Unnamed Trib.	Beamer Reservoir	29	18S	4 W	2,800	
146	Inman Cr.	-	1	17S	6 W	1,500	
129	Bear Cr.	-	11	16S	6 W	2,500	
147	Jones Cr.	-	18	16S	5 W	4,000	
156	Owens Cr.	-	3	16S	6 W		
573	Owens Cr.	-	35	15S	6 W	8,200	
174	Ferguson Cr.	-	15	15S	6 W	4,800	
134	Ferguson Cr.	-	14	15S	6 W	6,000	
132	Eber Cr.	-	23	15S	6 W	3,950	
167	Unnamed Trib.	-	23	15S	6 W	5,700	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 5. Santiam

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	MUDDY CREEK						
	little Muddy Cr.						
243	Unnamed Trib.	-	36	14S	3 W	3,400	
194	CALAPOOIA RIVER	Dollar	33	14S	1 E		Poor storage
246	CALAPOOIA RIVER	Upper Holley	30	14S	1 E		
187	CALAPOOIA RIVER	Calapooia-Oak Cr.	4	14S	2 W		
182	CALAPOOIA RIVER	Brownsville Project	31	13S	2 W		Diversion
242	Unnamed Trib.	-	14	14S	1 W	1,300	
191	Courtney Cr.	-	22	14S	2 W	6,400	
185	Butte Cr	Butte Cr. Upper	4	13S	2 W	3,400	
184	Unnamed Trib.	-	19	13S	2 W	5,400	
224	Oak Cr.	-	1	13S	2 W	7,200	
	SANTIAM RIVER						
217	North Santiam R.	Mowich & Duffy Lakes	25	12S	7 E		
202	North Santiam R.	Independence Prairie	19	12S	7 E		Poor abutments
183	North Santiam R.	Bruno	15	11S	7 E		Diversion
216	North Santiam R.	Minto	10	11S	7 E		Excessive dam length
240	North Santiam R.	Tunnel	20	10S	7 E		
239	North Santiam R.	Tom Cr.	17	10S	6 E		Development in reservoir
214	North Santiam R.	Mill City	29	9S	4 E		Development in reservoir
220	North Santiam R.	Mill City	30	9S	4 E		Development in reservoir
215	North Santiam R.	Niagara	30	9S	4 E		Development in reservoir
198	North Santiam R.	Gates	29	9S	3 E		Development in reservoir
211	North Santiam R.	Mehama No. 1	25	9S	2 E		Development in reservoir
213	North Santiam R.	Mehama Diversion	26	9S	2 E		Development in reservoir
212	North Santiam R.	Mehama No. 2	18	9S	2 E		Development in reservoir
210	North Santiam R.	Mehama	14	9S	1 E		Development in reservoir
231	North Santiam R.	Salem-Woodburn Project Diversion	22	9S	1 E		Development in reservoir
223	North Santiam R.	North Santiam Diversion	17	9S	1 E		Development in reservoir
178	North Santiam R.	Aumsville	12	9S	1 W		Diversion
230	North Santiam R.	Salem Project Diversion	30	9S	1 W		Diversion
209	Marion Cr.	Marion Lake	6	12S	8 E		
227	Pamelia Cr.	Pamelia	10,11	7S	E		3 Units
186	Breitenbush R.	Byars Cr.	29	9S	6 E		
222	North Fork	-		9S	8 E		
201	North Fork	Hot Springs	21	9S	7 E		Diversion
236	South Fork	-	1	10S	7 E		
195	Little North Sant.	Elkhorn	26	8S	4 E		Diversion
188	Little North Sant.	Canyon Cr.	36	8S	3 E		
196	Little North Sant.	Elkhorn, Upper	2	9S	3 E		

AD-A036 765 PACIFIC NORTHWEST RIVER BASINS COMMISSION VANCOUVER WASH F/G 8/6
THE WILLAMETTE BASIN COMPREHENSIVE STUDY OF WATER AND RELATED L--ETC(U)
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POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 5. Santiam

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	SANTIAM R. (cont.)						
	North Santiam R.						
197	Little North Sant.	Elkhorn	9	9S	3 E		
206	Little North Sant.	-	8	9S	3 E		
241	Little North Sant.	Lyons	8	9S	3 E	110,000	
179	Bear Br.	-	28	9S	1 W	16,800	
193	South Santiam R.	Creek Junction	4	14S	5 E		
235	South Santiam R.	Upper Soda	26	13S	4 E		
228	South Santiam R.	Patterson	35	13S	3 E		
207	South Santiam R.	McDowell Cr.	23	13S	1 W		Development in reservoir
233	South Santiam R.	Scio Project Diversion	34	12S	1 W		
247	South Santiam R.	Waterloo No. 1	28	12S	1 W		Development in reservoir
250	South Santiam R.	Waterloo Diversion	28	12S	1 W		Development in reservoir
248	South Santiam R.	Waterloo No. 2	20	12S	1 W		Development in reservoir
249	South Santiam R.	Waterloo No. 3	19	12S	1 W		Development in reservoir
176	South Santiam R.	Albany Site	11	12S	2 W		Diversion
229	Middle Santiam R.	Pyramid	36	12S	5 E		Poor Storage
190	Middle Santiam R.	Chimney Site	20	12S	5 E		
180	Middle Santiam R.	Bear Cr.	24	12S	4 E		
226	Quartzville Cr.	Packers Gulch	24	11S	3 E		
251	Wiley Cr.	-	7	14S	2 E	65,000	
204	Wiley Cr.	Log Pond	35	13S	1 E		Excessive dam length
177	Ames Cr.	-	4	14S	1 E	2,600	
208	McDowell Cr.	-	1	13S	1 W	25,000	
221	Noble Cr.	-	16	13S	1 W	12,600	
244	Hamilton Cr.		17	12S	1 E	12,000	
199	Hamilton Cr.	-	23	12S	1 W	20,300	Excessive dam length
225	Onehorse Slough	-	33	11S	1 W	3,400	
232	Crabtree Cr.	Sawmill	22	11S	1 E	70,000	
192	Crabtree Cr.		20	11S	1 E	12,600	Poor abutments
181	Beaver Cr.	-	17	11S	1 W	9,800	
245	Thomas Cr.	Upper Indian Prairie Site	23	10S	2 E		
205	Thomas Cr.	Indian Prairie Site	15	10S	2 E		Alternate to No. 245
238	Thomas Cr.	-	7	10S	2 E	13,100	Excessive dam length
234	Thomas Cr.	Section 12 Site	12	10S	1 E		Excessive dam length
203	Thomas Cr.	Jordan	5	10S	1 E	93,000	
218	Neal Cr.	-	23	10S	1 E	3,100	Excessive dam length
219	Neal Cr.	-	8	10S	1 E		Excessive dam length
237	Sucker Slough	-	5	10S	1 W	7,200	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 6. Coast Range

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
327	MARYS RIVER	Summit	32	10S	7 W	25,000	
334	MARYS RIVER	Wren	29	11S	6 W		
574	MARYS RIVER	Noon	34	11S	6 W	115,000	
305	MARYS RIVER	Philomath	11	12S	6 W		
282	Horton Cr.	-	11	11S	7 W	4,500	
319	Tum Tum R.	-	27	11S	7 W	60,000	
333	Woods Cr.	-	4	12S	6 W	9,800	
	Greasy Cr.						
313	Rock Cr.	-	24	12S	7 W	4,100	
	Muddy Cr.						
299	Oliver Cr.	-	14	14S	6 W	9,600	
310	Reese Cr.	-	2	14S	6 W	9,600	
259	Beaver Cr.	-	11	13S	6 W	13,000	
275	Evergreen Cr.	-	22	12S	6 W	1,900	
298	Oak Cr.	-	19	11S	5 W	3,200	
262	LUCKIAMUTE RIVER	-	19	9S	7 W	12,940	
257	LUCKIAMUTE RIVER	Bald Mountain	29	9S	7 W		
321	LUCKIAMUTE RIVER	Seekay	34	9S	7 W		
286	LUCKIAMUTE RIVER	Kings Valley	12	10S	7 W		
283	LUCKIAMUTE RIVER	Hoskins	19	10S	6 W	85,000	Poor abutments
285	LUCKIAMUTE RIVER	Kings Valley	9	10S	6 W		
302	LUCKIAMUTE RIVER	Pedee	33	9S	6 W	130,000	
304	LUCKIAMUTE RIVER	Pedee Diversion	26	9S	6 W		
252	LUCKIAMUTE RIVER	Airlie	15	9S	5 W	300,000*	
328	Vincent Cr.	-	32	10S	6 W		
598	Unnamed Trib.	-	14	9S	8 W	9,000	
309	Price Cr.	-	27	10S	6 W	5,800	
290	Maxfield Cr.	Upper Maxfield Cr.	14	10S	6 W	3,300	
289	Maxfield Cr.	Lower Maxfield Cr.	14	10S	6 W	11,300	
311	Ritner Cr.	-	31	9S	6 W		
549	Ritner Cr.	-	5	10S	6 W	15,740	
303	Pedee Cr.	-	33	9S	6 W		
587	Pedee Cr.		20	9S	6 W		
297	North Fork	-	17	9S	6 W	9,000	
284	Jont Cr.	-	31	9S	5 W	8,500	
654	Little Luckiamute R.		13	8S	7 W	17,000	
260	Little Luckiamute R.	Black Rock	13	8S	7 W	6,000	
599	Little Luckiamute R.	-	18	8S	6 W	14,600	
278	Little Luckiamute R.	Falls City	17	8S	6 W		
287	Little Luckiamute R.	Lewisville	9	9S	5 W	110,000	
600	Wamire Cr.	-	15	8S	6 W	5,800	
601	Teal Cr.	-	28	8S	6 W	14,100	
550	Teal Cr.	-	27	8S	6 W	25,000	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 6. Coast Range

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	TUCKIAMUTE RIVER (cont.)						
	Little Tuckiamute R.						
	Teal Cr.						
575	Grant Cr.	-	34	8S	6 W	5,500	
602	Fern Cr.	-	25	8S	6 W	860	
603	Cooper Hollow	-	5	9S	5 W	1,700	
604	Cooper Hollow	-	9	9S	5 W	1,640	
326	Unnamed Trib.	Parker Site	20	9S	4 W	5,500	
317	Soap Cr.	Sulphur Spring	34	10S	5 W	13,000	
316	Staats Cr.	-	4	10S	5 W	3,600	
	ASH CREEK						
296	North Fork	-	6	8S	5 W	3,100	
291	Middle Fork	-	14	8S	5 W	3,000	
605	RICKREALL CREEK	-	3	8S	6 W		
268	RICKREALL CREEK	Dallas	36	7S	6 W	30,000	
606	RICKREALL CREEK	-	36	7S	6 W	20,000	
274	Ellendale Cr.	-	24	7S	6 W	3,200	
315	SPRING VALLEY CREEK	-	26	6S	4 W	4,800	
	YAMHILL RIVER						
264	South Yamhill R.	Cedar Cr.	33	5S	8 W	50,000	
263	South Yamhill R.	Agency	12	6S	8 W	78,000	
280	South Yamhill R.	Fort Yamhill, lower	18	6S	7 W		Development in reservoir
279	South Yamhill R.	Fort Sheridan	8	6S	7 W		Development in reservoir
329	South Yamhill R.	Wallace Bridge	14	6S	7 W		Development in reservoir
330	South Yamhill R.	Willamina	12	6S	7 W		
585	Ead Cr.	-	29	5S	8 W	11,700	
607	Cedar Cr.	-	32	5S	8 W	5,900	
608	Unnamed Trib.	-	4	6S	8 W	5,700	
609	Agency Cr.	-	16	5S	8 W	24,900	
610	Agency Cr.	-	16	5S	8 W	26,000	
254	Agency Cr.	-	26	5S	8 W	25,000	
611	Agency Cr.	-	36	5S	8 W	27,300	
612	Yoncalla Cr.	-	15	5S	8 W	9,000	
552	Rogue R.	-	17	6S	8 W	10,000	
314	Rogue R.	-	9	6S	8 W	12,000	
613	Rogue R.	-	11	6S	8 W	4,100	
614	Rock Cr.	Cascade	26	6S	8 W	22,750	
615	Rock Cr.	-	14	6S	8 W		
553	Rowell Cr.	-	8	6S	7 W		
584	Rowell Cr.	-	17	6S	7 W	26,700	
266	Cosper Cr.	-	19	5S	7 W	9,600	
554	Cosper Cr.	-	32	5S	7 W	14,300	
555	Gold Cr.	-	21	6S	7 W	14,500	
332	Willamina Cr.	Willamina Cr., upper	36	4S	7 W	17,600	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 6. Coast Range

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	YAMHILL RIVER (cont.)						
	South Yamhill R.						
261	Willamina Cr.	Buck Hollow	12	5S	7 W	84,000	
331	Willamina Cr.	Willamina Cr., lower	13	5S	7 W	19,500	Excessive dam length
335	Willamina Cr.	Yamhill Project	25	5S	7 W		Diversion
616	East Fork	-	28	4S	6 W	11,100	
617	East Fork	-	32	4S	6 W	13,300	
556	East Fork	-	5	5S	6 W	11,500	
582	East Fork	-	5	5S	6 W		
618	La Toutena Mary Cr.	-	32	4S	6 W	2,500	
619	Coast Cr.		10	5S	7 W	20,100	
265	Coast Cr.	-	10	5S	7 W	22,000	
318	Tindle Cr.	-	23	5S	7 W	11,700	
620	Ash Cr.	-	31	5S	6 W	3,400	
281	Mill Cr.	Gorge	8	7S	6 W	53,000	
312	Rock Cr.	-	28	5S	6 W	4,000	
653	Unnamed Trib.		1	6S	6 W		
258	Ballston Slough	-	13	6S	6 W	4,200	
272	Deer Cr.	Deer Cr. No. 4	25	4S	6 W	8,500	
652	Deer Cr.		36	4S	6 W		
645	Deer Cr.		2	5S	6 W		
269	Deer Cr.	-	11	5S	6 W	33,000	
271	Deer Cr.	Deer Cr. No. 2	14	5S	6 W	25,000	
270	Deer Cr.	Deer Cr. No. 1	30	5S	5 W	25,000	
273	Dupee Cr.	-	13	5S	6 W	5,950	
621	Muddy Cr.	Upper Muddy Cr.	32	4S	5 W	3,300	
294	Muddy Cr.	Muddy Cr., Upper	4	5S	5 W	9,700	
29.	Muddy Cr.	-	17	5S	5 W	18,400	
622	Middle Fork	-	28	4S	5 W	1,900	
576	Salt Cr.	-	15	7S	5 W	3,600	
557	Salt Cr.	-	1	6S	5 W	5,300	
558	Salt Cr.	-	29	5S	4 W	8,400	
577	West Fork	-	11	7S	6 W	9,500	
325	Unnamed Trib.	-	32	6S	5 W	2,000	
324	Unnamed Trib.	-	18	6S	5 W	1,200	
559	Ash Swale	-	29	5S	4 W		
308	Unnamed Trib.	Plum Valley	17	6S	4 W	1,630	
255	Athey Cr.	-	9	6S	4 W	925	
267	Cozine Cr.	-	26	4S	5 W		
277	North Yamhill R.	Fairdale, upper	29	2S	5 W	35,000	
276	North Yamhill R.	Fairdale, lower	28	2S	5 W	120,000	
307	North Yamhill R.	Pike, upper	27	2S	5 W		

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 6. Coast Range

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	YAMHILL RIVER (cont.)						
306	North Yamhill R.	**Pike, lower**	25	2S	5 W	75,000	
292	Haskins Cr.	Moores Valley	4	3S	5 W	30,000	
320	Turner Cr.	-	24	2S	5 W	29,000	
322	Unnamed Trib.	-	19	2S	4 W	6,000	
323	Rowland Cr.	-	33	2S	4 W	4,830	
256	Baker Cr.	-	15	4S	5 W	14,600	
288	Baker Cr.	-	18	4S	4 W	900	
263	Panther Cr.	Carlton Water Supply	18	3S	5 W		
301	Panther Cr.	-	22	3S	5 W	19,500	
300	Palmer Cr.	-	16	4S	3 W	11,550	
623	CHEHALEM CR.	-	13	3S	3 W	2,200	
562	CHEHALEM CR.	-	30	3S	2 W	2,700	
624	Unnamed Trib.	-	5	3S	3 W	840	
581	Unnamed Trib.		18	3S	3 W	2,300	
561	Unnamed Trib.	-	18	3S	3 W	360	
656	Unnamed Trib.	-	20	3S	3 W	360	
625	Unnamed Trib.	-	8	3S	3 W	350	
657	Unnamed Trib.	-	16	3S	3 W		
628	Unnamed Trib.	-	15	3S	3 W	30	
560	Unnamed Trib.		28	2S	3 W		
578	Unnamed Trib.		33	2S	3 W	2,400	
627	Unnamed Trib.	-	10	3S	3 W	2,360	
626	Unnamed Trib.	-	35	2S	3 W	300	
	Bryon Cr.						
629	Unnamed Trib.	-	3	3S	3 W	500	
630	Bronson Cr.	-	13	3S	3 W	300	
631	Unnamed Trib.	-	13	3S	3 W	1,000	
632	Unnamed Trib.	-	13	3S	3 W	60	
633	Harvey Cr.	-	24	3S	3 W	350	
634	Harvey Cr.	-	24	3S	3 W	880	
580	SPRING BROOK	-	16	3S	2 W	2,640	
635	SPRING BROOK	-	21	3S	2 W	720	
636	SPRING BROOK	-	28	3S	2 W	1,200	
563	Hess Cr.		20	3S	2 W		
637	Hess Cr.	-	29	3S	2 W	2,200	
638	Hess Cr.	-	28	3S	2 W	2,000	
639	Unnamed Trib.	-	27	3S	2 W	740	
295	NEWLAND CREEK	-	7	3S	1 E	1,100	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 7. Pudding

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
393	MILL CREEK	Coon Hollow	32	8S	1 E		
345	MILL CREEK	Stayton Dump	31	8S	1 E	890	
640	MILL CREEK	-	31	8S	1 E	6,500	
391	MILL CREEK	Spenner	1	9S	1 W	4,450	
367	MILL CREEK	-	3	9S	1 W	5,950	
406	MILL CREEK	-	3	9S	1 W		
395	MILL CREEK	Turner	25	8S	2 W		
396	MILL CREEK	Turner	20	8S	2 W		
392	MILL CREEK	State	18	8S	2 W		
641	Beaver Cr.	-	29	8S	1 W	11,800	
564	Beaver Cr.	-	30	8S	1 W		
407	Beaver Cr.	-	19	8S	1 W		
589	North Fork	-	23	8S	1 W		
405	McKinney Cr.	-	32	8S	2 W		
381	Rodgers Cr.	-	36	8S	3 W	1,000	
382	Battle Cr.	Rosedale	21	8S	3 W	3,000	
358	Battle Cr.	-	22	8S	3 W	2,700	
565	Battle Cr	-	31	8S	2 W	3,800	
357	MOLALLA RIVER	Headwaters	29	7S	4 E		Poor storage
338	MOLALLA RIVER	Bee Ranch	15	7S	3 E	31,000	
375	MOLALLA RIVER	Pelkey	6	7S	3 E		
377	MOLALLA RIVER	Pine Cr.	31	6S	3 E		
376	MOLALLA RIVER	Pine Cr.	31	6S	3 E		
567	MOLALLA RIVER	Three Hundred	30	6S	3 E		
568	MOLALLA RIVER	Four Hundred	19	6S	3 E		
373	MOLALLA RIVER	North Fork	6	6S	3 E		
359	MOLALLA RIVER	Lower	31	5S	3 E		Diversion
349	MOLALLA RIVER	Dickey Diversion	26	5S	2 E		Diversion
348	MOLALLA RIVER	Dickey Bridge	14	5S	2 E	273,000	
368	MOLALLA RIVER	Molalla Diversion No. 1	11	5S	2 E		Diversion
408	MOLALLA RIVER	-	2	5S	2 E		Diversion
369	MOLALLA RIVER	Molalla No. 2	13	4S	1 E		Diversion
356	Table Rock Fork	Headwaters	1	7S	3 E		
374	North Fork	Dead Horse Canyon Cr.	36	5S	3 E		Poor storage
400	North Fork	-	33	5S	3 E		Poor storage
383	Russell Cr.	-	12	6S	2 E		
399	Cedar Cr.	-	35	5S	2 E		
343	Milk Cr.	Cedardale	6	5S	3 E		
397	Milk Cr.	Union Mills	21	4S	2 E		Excessive dam length
370	Milk Cr.	Mulino	17	4S	2 E		Development in reservoir
371	Nate Cr.	-	31	4S	3 E		
342	Cedar Cr.	Cedar Cr., Upper	18	4S	3 E	2,800	
341	Cedar Cr.	Cedar Cr., Lower	23	4S	2 E	2,000	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 7. Pudding

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	MOLALLA RIVER (cont.)						
	Milk Cr.						
339	Buckner Cr.	-	15	4S	2 E	5,400	
344	Pudding R.	Coleman	4	8S	1 W	4,500	
403	Pudding R.	-	19	7S	1 W		
378	Pudding R.	Pratum	13	7S	2 W	3,600	
386	Pudding R.	Selah	5	7S	1 W	22,000	
350	Unnamed Trib.	-	10	8S	1 W	5,200	
379	Beaver Cr.	Riches	21	7S	1 W	4,200	
361	Beaver Cr.	Lower Beaver Cr.	17	7S	1 W	5,700	
351	Drift Cr.	Fisher	6	8S	1 E	21,200	
410	Drift Cr.	-	36	7S	1 W	9,000	
362	Drift Cr.	Lower Drift Cr.	16	7S	1 W	9,400	
353	East Fork	Hanson	9	8S	1 E	6,800	
390	Silver Cr.	Silverton	10	8S	1 E		Poor storage
389	Silver Cr.	Silver Crest	29	7S	1 E	25,000	
352	Silver Cr.	Grange	19	7S	1 E	80,000	
363	Silver Cr.	Lower Grange	18	7S	1 E		
365	Silver Cr.	Meridian, Upper	7	7S	1 E		
364	Silver Cr.	Meridian, Lower	12	7S	1 W	25,000	
593	South Fork	-	23	8S	1 E	24,600	
387	South Fork	Silver Falls	14	8S	1 E		
644	North Fork		7	8S	2 E		
388	North Fork	Silver Falls	12	8S	1 E		
355	Abiqua Cr.	Headwaters	2	8S	2 E		
402	Abiqua Cr.	-	19	7S	2 E		Poor storage
409	Abiqua Cr.	Camp Cr.	13	7S	1 E		
340	Abiqua Cr.	Upper Abiqua	13	7S	1 E		
398	Abiqua Cr.	-	11	7S	1 E	15,000	
366	Abiqua Cr.	Middle Abiqua	28	6S	1 E		
360	Abiqua Cr.	Lower Abiqua	30	6S	1 E		
642	Little Pudding R.	Hazel Green	33	6S	2 W	10,500	
354	Little Pudding R.	Hazel Green	34	6S	2 W		Poor storage
643	Zollner Cr.	-	3	6S	1 W	310	
413	Zollner Cr.	Zollner	34	5S	1 W		
385	Butte Cr.	Scotts Mills	9	7S	2 E		
346	Butte Cr.	Crooked Finger	4	7S	2 E		
347	Butte Cr.	Del Aire Ranch	32	6S	2 E	4,400	
569	Butte Cr.	Coal Cr.	30	6S	2 E	40,000	
384	Butte Cr.	Scotts Mills	24	6S	1 E	8,300	
590	Fall Cr.	-	14	7S	2 E		
586	Coal Cr.	-	4	7S	2 E	15,600	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 7. Pudding

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	MOLALLA RIVER						
	Butte Cr.						
583	Beaver Cr.	-	20	6S	2 E		
337	Beaver Cr.	-	17	6S	2 E	5,700	
588	Unnamed Trib.	-	26	6S	1 E		
412	Rock Cr.	Wilhoit, Upper	16	6S	2 E		
411	Rock Cr.	Wilhoit, Lower	8	6S	2 E		
401	Rock Cr.	-	5	6S	2 E		
380	Rock Cr.	-	17	5S	1 E	12,000	
394	Teasel Cr.	-	28	5S	2 E	765	
646	Bear Cr.	Bear Cr., Lower	29	4S	1 E	2,000	
336	Bear Cr.	-	19	4S	1 E		
404	Unnamed Trib.	-	5	5S	1 E	320	
372	Unnamed Trib.	Needy	32	4S	1 E		

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 8. Tualatin

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
419	TUALATIN RIVER	-	20	1S	5 W		
447	TUALATIN RIVER	-	20	1S	5 W		
415	TUALATIN RIVER	Cherry Grove,	32	1S	4 W		
422	TUALATIN RIVER	Upper Gaston	34	1S	4 W	68,000	
418	Scoggins Cr.	Forest Dale	35	1N	5 W		
428	Scoggins Cr.	Scoggins No. 1A	27	1S	4 W		
441	Gales Cr.	-	20	2N	5 W	14,500	
423	Gales Cr.	Glenwood	23	2N	5 W	40,000	
421	Gales Cr.	Gales Cr. No. 2A	17	1N	4 W		
420	Gales Cr.	-	21	1N	4 W	60,000	
434	Iler Cr.	Site No. 5	11	1N	5 W		
433	Iler Cr.	Site No. 4	12	1N	5 W		
430	Clear Cr.	Site No. 1	13	1N	5 W		
431	Clear Cr.	Site No. 2	13	1N	5 W		
432	Clear Cr.	Site No. 3	18	1N	4 W		
	Dairy Cr.						
440	East Fork	-	28	3N	3 W	10,000	
416	East Fork	-	16	2N	3 W		
417	East Fork	-	22	2N	3 W	47,000	
438	Bledsoe Cr.	-	27	2N	3 W	8,000	
425	West Fork	Manning	10	2N	4 W		
414	West Fork	Banks	25	2N	4 W		
449	Unnamed Trib.	-	5	2N	4 W	8,100	
450	Unnamed Trib.	-	5	2N	4 W	3,800	
435	Witcher Cr.	Tolke Canyon	3	2N	4 W	6,100	
	Canyon Cr.						
446	Sadd Cr.	-	33	2N	4 W	5,200	
445	Park Farms Cr.	-	34	2N	4 W	6,250	
426	McKay Cr.	-	24	2N	3 W	18,300	
429	McKay Cr.	Shady Brook	30	2N	2 W		
436	Rock Cr.	Upper Rock Cr.	18	1N	1 W		
	Beaverton Cr.						
442	Johnson Cr.	-	17	1S	1 W	2,000	
443	McFee Cr.	-	18	2S	2 W	12,500	
437	Baker Cr.	-	15	2S	2 W	4,900	
439	Chicken Cr.	-	19	2S	1 W	1,400	
647	Cedar Cr.	-	31	2S	1 W	860	
	Fanno Cr.						
448	Unnamed Trib.	-	34	1S	1 W	2,760	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 9. Clackamas

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	PARROTT CREEK						
504	Unnamed Trib.	-	31	3S	2 E	2,000	
495	BEAVER CREEK	-	22	3S	2 E	1,700	
648	BEAVER CREEK	-	18	3S	2 E	2,900	
496	BEAVER CREEK	-	18	3S	2 E	2,800	
492	ABERNETHY CREEK	-	19	3S	3 E	6,500	
452	CLACKAMAS RIVER	Big Bottom	25	6S	7 E		
451	CLACKAMAS RIVER	Big Bottom	26	6S	7 E	120,000	
469	CLACKAMAS RIVER	Lower Austin Point	22	6S	6 E		
476	CLACKAMAS RIVER	Ripplebrook	34	5S	6 E		
473	CLACKAMAS RIVER	Nowhere Meadows	21	5S	6 E		Excessive overburden
463	CLACKAMAS RIVER	Fish Cr.	2	5S	5 E		
462	CLACKAMAS RIVER	Fish Cr.	2	5S	5 E		Poor storage
486	CLACKAMAS RIVER	South Fork	29	4S	5 E		
487	CLACKAMAS RIVER	South Fork	20	4S	5 E		Poor storage
470	CLACKAMAS RIVER	Lower Clackamas	21	2S	3 E		
453	CLACKAMAS RIVER	Carver	18	2S	3 E		Development in reservoir
471	Squirrel Cr.	Lower Lake	3	9S	8 E		
466	Squirrel Cr.	Fish Lake	34	8S	8 E		
491	Squirrel Cr.	Surprise Lake	27	8S	8 E		
474	Collawash R.	Oh Boy	6	8S	7 E		
455	Collawash R.	Collawash	25	7S	6 E		
507	Collawash R.	Upper Austin Point	27	6S	6 E	180,000	
	East Fork						
479	Round Cr.	Round Lake	17	8S	7 E		
456	Hot Springs Fork	Collawash	14	7S	5 E		
457	Pansey Cr.	Collawash	13	7S	5 E		
454	Oak Grove Fork	Clackamas Lake	26	5S	8½E		
482	Oak Grove Fork	Shell Rock	27	5S	8 E		
481	Oak Grove Fork	Shell Rock, Lower	2	6S	7 E		Limited storage
506	Unnamed Trib.	-	12	5S	8 E		
460	Dinger Cr.	Dinger Lake	9	5S	8 E		
493	Anvil Cr.	-	17	5S	8 E		
489	Stone Cr.	-	27	5S	8 E		
490	Unnamed Trib.	Summit Lake	23	6S	8 E		
483	Shellrock Cr.	-	17	5S	7 E		
484	Shellrock Cr.	Shellrock Lake	23	5S	7 E		
468	Unnamed Trib.	Hidaway Lake	20	5S	7 E		
475	Unnamed Trib.	Pyramid Lake	11	5S	7 E		
458	Cot Cr.	Cottonwood Meadows	28	5S	7 E		
459	Cripple Cr.	Cripple Cr. Lake	19	5S	7 E		
465	Roaring R.	Fish Creek	34	4S	6 E		

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 9. Clackamas

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
	CLACKAMAS RIVER (cont.)						
477	Roaring R.	-	5	5S	6 E		
488	Squaw Cr.	Squaw Lake	13	4S	6 E		
485	Unnamed Trib.	Shining Lake	36	4S	6 E		
480	South Fork	Serene Lake	7	5S	7 E		
478	Unnamed Trib.	Rock Lake	8	5S	7 E		
464	Fish Cr.	-	3	6S	5 E		
498	Fish Cr.	-	14	5S	5 E		
499	Fish Cr.	-	11	5S	5 E		
472	North Fork	North Fork Diversion	8	4S	5 E		
497	Eagle Cr.	-	26	3S	5 E	21,000	
461	Eagle Cr.	-	10	3S	4 E	140,000	
655	North Fork	-	7	3S	5 E		
502	North Fork	-	11	3S	4 E	1,300	
	Deep Cr.						
501	Unnamed Trib.	-	27	2S	4 E	2,200	
505	Tickle Cr.	-	8	2S	4 E	1,000	
503	Noyer Cr.	-	2	2S	3 E	22	
467	Clear Cr.	-	4	3S	3 E	60,000	
500	Little Clear Cr.	-	22	3S	3 E	5,200	
494	Bargfeld Cr.	-	4	3S	3 E	1,600	

POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 10. Columbia

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
566	FAIRVIEW CREEK	-	20	1N	3 E	1,740	
512	MOUNT SCOTT CREEK	-	3	2S	2 E	3,600	
509	JOHNSON CREEK	-	28	1S	4 E	1,030	
649	JOHNSON CREEK	-	23	1S	3 E	4,200	
592	JOHNSON CREEK	-	19	1S	4 E	1,010	
515	Unnamed Trib.	-	26	1S	3 E	3,260	
650	Unnamed Trib.	-	15	1S	3 E	1,200	
651	Unnamed Trib.	-	17	1S	3 E	1,000	
591	Unnamed Trib.	-	19	1S	3 E	1,080	
	SCAPPOOSE CREEK						
514	North Fork	-	18	4N	2 W	4,100	
513	North Fork	-	17	4N	2 W	18,200	
516	McNULTY CREEK	-	13	4N	2 W	2,600	
510	MILTON CREEK	-	16	5N	2 W	10,000	
511	MILTON CREEK	-	27	5N	2 W	14,300	
508	Cox Cr.	-	2	4N	2 W	4,200	

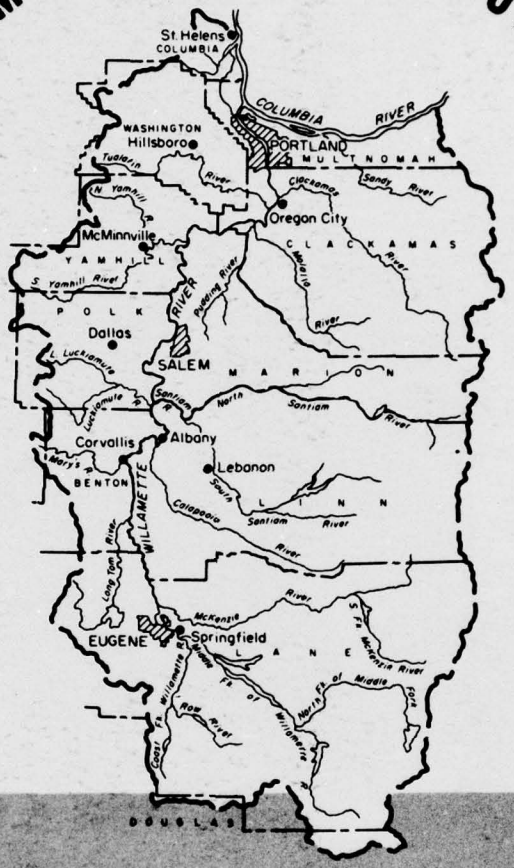
POTENTIAL DAM AND RESERVOIR SITES INVESTIGATED

WILLAMETTE BASIN COMPREHENSIVE STUDY

SUBBASIN 11. Sandy

INDEX NO.	STREAM	SITE NAME	LOCATION SEC	TWP	RNG	STORAGE CONSIDERED	REMARKS
543	SANDY RIVER	Yocum Ridge		2S	8 E		
525	SANDY RIVER	Last Chance Mtn.		2S	8 E		
533	SANDY RIVER	Old Maids Flat		2S	8 E		
545	SANDY RIVER	Zigzag	36	2S	7 E		
530	SANDY RIVER	Marmot	33	2S	7 E		Diversion
538	SANDY RIVER	Swimming Hole	30	1S	5 E		
524	SANDY RIVER	Indian John	23	1S	4 E		
539	SANDY RIVER	Troutdale	36	1N	3 E		
544	Muddy Fork	Yocum Ridge		2S	8 E		
535	Zigzag R.	Rhododendron	16	3S	8 E		
546	Zigzag R.	Zigzag	11	3S	7 E		
531	Salmon R.	Meadows	23	4S	8 E		Excessive dam length
527	Salmon R.	-	17	4S	8 E		
526	Salmon R.	Linney	18	4S	8 E	40,000	
517	Salmon R.	Big Horn	34	3S	7 E		
537	Salmon R.	South Fork	27	3S	7 E		
529	Salmon R.	Marmot	8	3S	7 E		
532	Mud Cr.	-	11	4S	8½E		
571	Cedar Cr.	-	36	2S	5 E	5,000	
522	Bull Run R.	Deer Meadows		1S	7 E		
518	Bull Run R.	Blazed Alder		1S	7 E		
520	Blazed Alder Cr.	-	25	1S	7 E		
523	Hickman Cr.	Hickman Lake	2	2S	7 E		
521	Log Cr.	Blue Lake	12	1S	7 E		
534	North Fork	Palmer Lake	7	1N	7 E		
519	North Fork South Fork	Blazed Alder	2	1S	6 E		
536	Cedar Cr.	-	25	1S	6 E		
528	Little Sandy R.	Little Sandy	8	2S	7 E	3,900	
542	Trout Cr.	-	24	1S	4 E		
541	Gordon Cr.	-	7	1S	5 E	23,400	
540	Beaver Cr.	-	7	1S	4 E		

COMPREHENSIVE STUDY



Willamette Basin

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